DEPARTMENT OF THE INTERIOR

ANNUAL REPORT

OF THE

TOPOGRAPHICAL SURVEYS BRANCH

1916-17

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REPORT

OF THE

SURVEYOR GENERAL OF DOMINION LANDS

Owing to the falling-off of immigration the Dominion Lands Surveys appropriation for 1916-17 was reduced to $976,300. In accordance with the department's general policy of retrenchment during the war, a further saving of $202,050 was made, the amount expended being only $774,250, or $269,250 less than the previous year. As a consequence, the number of parties in the field was reduced to fifty, the smallest number for several years.

BLOCK OUTLINE SURVEYS.

In recent times settlers have been following down the great waterways of the North and forming settlements in remote districts. This necessitated the extension of meridian and base line surveys to include those settlements in the Dominion Lands system. The extension of these lines is now so far advanced that the number of base line survey parties could be reduced to three. The total mileage surveyed was 568, a somewhat larger average than for the preceding year.

One of these parties surveyed short portions of base lines east and west of the Sixth meridian from township 92 to township 112. This will allow of the subdivision into townships of all the land in this latitude and west of Peace river which is suitable for settlement. The surveyor reports a stretch of good, fairly open country between Peace river and the Sixth meridian and north of township 100; he also reports an area near Hay lake, which lies in the vicinity of township 112 and about thirty-six miles west of the Sixth meridian, where thousands of tons of first-class wild hay could be cut in a season. The surface of the land in this district is, as a rule, lightly wooded with poplar and willow, but a few stretches of heavy spruce and poplar were found, the trees measuring up to twenty-four inches in diameter.

A second party surveyed base lines in the lower Peace river valley, just west of lake Athabaska. This area is very level and during high water parts of it are flooded. The soil is alluvial and patches of swamp and muskeg are frequent. The district is excellent for stock raising as hay grows in abundance in all the open places and vast stretches of hay meadows are found, more especially south of the 29th base line (the north boundary of township 112). On the ridges some good timber grows, consisting of spruce, birch, poplar, tamarack, and willow.

The third party ran portions of the 19th and 20th base lines just east of the Fourth meridian in the drainage area of Churchill river. The original forest growth has been burned off and the district has so often been fire swept that the accumulation of mould is nowhere deep. A large block along the 20th base line (north boundary of township 76) contains considerable good land. The surface is generally rolling, and the district is most suitable for ranching as good hay grows almost everywhere, especially in the fire swept areas. Along Beaver and Churchill rivers are numerous rapids, and in many cases the fall is such that a large amount of power could be developed. This may yet prove very valuable.

TOWNSHIP SUBDIVISION.

The subdivision of townships was again carried on under daily pay, work by contract having been discontinued. The results give additional proof that the present method is much more satisfactory in every way.

Fifteen parties were engaged on regular subdivision, one operating in Manitoba, three in Saskatchewan, and eleven in Alberta. The trend of settlement was found to be still strongly towards the Peace river district, due partly to the large amount of desirable land in that locality and partly to the newly-constructed line of the Edmonton Dunvegan and British Columbia railway. As a consequence, nine of the eleven parties operating in Alberta were scattered over that district, one of these being southwest of Lesser Slave lake, two southeast of Dunvegan, two in the Peace River block, and four in the Peace river valley north of the town of Peace River. Of the remaining two parties in Alberta, one was working southeast of Lac La Biche and the other along the line of the Alberta and Great Waterways railway, now being constructed. When this line has been completed to McMurray a decided impetus will be given to the settlement of that district.

The three parties in Saskatchewan were working north of Prince Albert. To facilitate settlement around Torch and Candle lakes the Provincial Government is improving the road leading to the district from the south.

The party in Manitoba subdivided lands along the east shore of lake Winnipeg in the vicinity of the mouth of Bloodvein river.

REGULAR TOWNSHIP SUBDIVISION, 1916.

Surveyor.	Total mileage.	*Total cost.	Cost per mile.
		$	$ cts.
Baker, J. C.	504	18,396	36 50
Brenot, L.	428	19,265	45 01
Buchanan, J. A.	599	17,413	29 07
Christie, W.	465	15,793	33 96
Fawcett, S. D.	497	18,875	37 98
Glover, A. E.	447	17,908	40 06
Jackson, J. E.	436	12,902	29 59
Johnston, J. H.	538	18,413	34 22
Knight, R. H.	532	18,224	34 26
Lighthall, A.	557	17,838	32 02
McEwen, D. F.	504	17,745	35 21
McGarry, P. J.	458	17,827	38 92
Norrish, W. H.	436	18,229	41 81
Pierce, J. W.	608	15,690	25 81
Seibert, F. V.	686	18,271	26 63
	7,695	262,789	34 15

* Total cost includes depreciation of the outfit used,

The comparison between subdivision under contract in 1914 and subdivision by day work in 1915 and 1916 is given below:—

Year.	Method.	No. of Parties.	Miles surveyed	Total cost.	Cost per mile.
				$	$ cts.
1914	Contract	18	7,686	229,303	29 83
1915	Day work	19	8,612	260,592	30 26
1916	Day work	15	7,695	262,789	34 15

The above statement shows the cost per mile of subdivision surveys under daily pay in 1916 as being four dollars and thirty-two cents more than for contract work in 1914. The chief reason for this is that in 1916 for the first time, levels were taken in connection with the subdivision by all of the regular parties engaged on this work; the cost is included in the total cost of survey, and is approximately three dollars per mile for the total miles of subdivision. In 1915 levelling was carried on by only four of the parties, and in order that a comparison of the parties could be made on an equal basis, the cost of levelling was deducted.

If the same deduction were made for 1916 the comparative costs would be as follows:—

1914	Contract	$29 83
1915	Day work	30 26
1916	Day work	31 15

Since 1914 the increase in the prices of food is 30 per cent, survey labour 25 per cent, equipment and other expenses 10 per cent, an average of 22 per cent. A survey which, under contract, cost $29.83 in 1914 would have cost $36.39 in 1916, while the actual cost for the same survey by day work was only $31.15. The result is most gratifying.

In addition to the fifteen parties engaged on regular subdivision, five parties were employed in the railway belt of British Columbia on subdivision, traverse, and resurvey. Three parties were also engaged making subdivision surveys in northern Manitoba, where only small portions of the townships were required for settlement.

INSPECTION OF SURVEYS.

The abandonment of the contract system of performing subdivision surveys has greatly reduced the cost of inspection. In the past, five or six inspectors, each with a party, were engaged all or part of the season; last season only two surveyors were employed on this work, having no regular party with them and having only such assistance as was required for transportation, etc. Formerly only the parties working under contract were inspected, these being engaged on regular township subdivision. Under the present system an inspection is made of all the parties in the field. But though the number of parties examined has increased, the work of inspection is much less. In the past a considerable number of the surveyed lines in each township had to be checked for chainage and bearings to make sure that the work had not been carelessly performed. As contractors were paid according to the number of miles surveyed, there was every incentive for them to sacrifice accuracy for speed. Under the present system of daily pay there is no reason for the surveyor to slight his work, and the method of inspection has been modified to suit the changed conditions. The inspector now examines the surveyor's work by observing the actual methods employed in the various operations of chaining, levelling, turning angles, building monuments, offsetting survey posts, cutting out and blazing lines, etc. He furnishes a report on the methods of survey and of keeping the field notes and accounts, the instruments and equipment, and on the organization, general management, and efficiency of the party. In addition to this, the inspectors attend to the disposal of worn-out and unused outfits, the arranging for the wintering of the horses and other general business of this nature.

WATER AREAS.

The object of the stadia surveys is to revise quickly and at a moderate cost the survey of rivers, lakes and other bodies of water in townships subdivided many years ago. The drying up of these bodies of water has rendered the old township plans

unsatisfactory for the issuing of patents, and traverses of these bodies are necessary before new plans can be issued. Eleven surveyors were employed on stadia traverses in Saskatchewan and Alberta. They also reported on the progress of settlement, the amount of land under cultivation, the progress of grading on road allowances, and the condition of the survey monuments encountered.

The following table gives a synopsis of their work for the season:—

Surveyor.	Number of townships.	Areas reported on	Lakes traversed.	Mileage of lakes.	Mileage of rivers.	Mileage of tie lines.	Mileage of retracement.	Total mileage.	Total cost.	Cost per mile.	Cost per township.	Cost per lake.
									$	$ cts	$ cts	$ cts
Bennett, G. A.	71	554	356	544	131	135	8	818	6,148	7 51	86 59	13 98
Bowman, E. P.	38	118	305	479	189	173	47	888	5,965	6 72	156 97	14 02
Boulton, W. J.	81	0	344	446	308	143	38	935	6,496	6 94	80 20	11 17
Cowper, G. C.	93	81	88	195	190	42	16	443	5,843	13 19	62 83	33 63
Davies, T. A.	38	180	333	558	0	120	10	688	5,582	8 11	146 88	16 76
McKnight, J. H.	30	55	334	681	36	101	7	825	5,667	6 87	188 90	16 11
Palmer, P. E.	76	114	133	151	352	93	94	690	6,011	8 71	79 09	13 57
Rinfret, C.	82	142	288	368	64	83	59	574	6,293	10 96	76 74	19 89
Scott, W. A.	76	252	286	344	205	100	20	669	5,716	8 54	75 21	12 52
Soars, H. M. R.	33	145	328	556	107	88	6	757	5,736	7 58	173 82	14 66
Walker, C. M.	34	51	374	492	6	120	22	640	5,712	8 93	168 00	15 09
	652	1,692	3,169	4,814	1,588	1,198	327	7,927	65,169	8 22	99 95	15 46

ALBERTA—BRITISH COLUMBIA BOUNDARY.

The delimitation of the interprovincial boundary between British Columbia and Alberta, commenced in 1913, was continued under the same arrangements as for the preceding year. Mr. R. W. Cautley, D.L.S. and A.L.S., who acted for the Dominion and Alberta was employed on the actual work of establishing the boundary and erecting the monuments, while Mr. A. O. Wheeler, B.C.L.S., who represented British Columbia, made a photo-topographical survey of the surrounding country. The boundary was defined last season through Palliser, White Man, and Assiniboine passes, this completing the survey from the international boundary to the main line of the Canadian Pacific railway. The report of the commissioners for this part of the work is now being prepared and will probably be issued during the present calendar year.

SETTLEMENTS AND TOWNSITES.

This work was very limited last season. Small settlements were surveyed at Birch River, Norway House, Carrot River, Menisino, and Bedford Station in Manitoba, together with a few scattered lot, cemetery, and townsite surveys in the other provinces.

TIMBER BERTHS AND MINERAL CLAIMS.

Two timber berths and parts of three others, comprising thirty-six miles of boundary, were surveyed.

Before patents can be issued for mineral claims they must be surveyed by a duly qualified Dominion Land Surveyor under instructions of the Surveyor General. Forty-one claims were surveyed, the majority being gold-mining claims in Manitoba in the vicinity of Herb lake northeast of Pas, and Rice lake east of the southern part of lake Winnipeg.

RETRACEMENT AND RESURVEY.

Townships which were subdivided twenty-five or thirty years ago were not as carefully done as at present. In many cases also no trace of the original survey can be found. Even where the survey was marked by iron survey posts of the old style these were often removed by persons ignorant of their importance, or by those interested in destroying evidences of the survey. Although there is a $50 reward for evidence of this offence few convictions have been secured, and posts are still being displaced. When the survey marks are removed it is difficult for the settlers to find their boundaries, and it is the policy of the department to renew the monuments where the lands cannot be located. This is done only in cases where at least part of the lands affected are still vested in the Dominion.

In some cases the original survey was poorly executed, and a quarter-section returned as one hundred and sixty acres was often as much as forty acres over or under that area.

The correction of these errors is made under the authority of section 57 of the Dominion Lands Surveys Act, and the restoration of obliterated monuments under section 58 of the same act. The Department of Justice has recently ruled that these sections are not applicable to lands which have passed from the Dominion prior to the date on which the act was assented to, unless authorized by the legislature of the province in which the lands are situated. The provinces of Saskatchewan and Alberta have passed acts authorizing these surveys but Manitoba has not.

Three parties were engaged in restoring obliterated monuments, retracing old lines, and making resurveys where there was authority for doing so. They retraced or resurveyed 1,369 miles, besides running 110 miles of traverse.

Some of the early surveys of base lines and initial meridians were not very accurate, both in direction and measurement. As these lines are the governing lines of all other surveys a knowledge of their deviations and discrepancies is necessary for the management of the system of survey as a whole. One party was employed retracing old base lines where inaccuracies were suspected, over 500 miles of line being thus surveyed.

Four surveyors, each with an assistant only, were employed in travelling through Manitoba, Saskatchewan, and Alberta, attending to complaints, correcting errors, erecting monuments, and making various adjustments where the amount of work to be done at any one place did not warrant the expense of a survey party. They hired assistance locally when required.

YUKON SURVEYS.

In the Yukon Territory the work is mostly in connection with mining claims and is under the supervision of the Director of Surveys who resides at Dawson. He is assisted in the office by one draftsman.

STATEMENT OF MILEAGE SURVEYED.

The following is a comparison of the mileage surveyed each year since 1914:—

Nature of Survey.	April 1, 1914 to March 31, 1915.	April 1, 1915 to March 31, 1916.	April 1, 1916 to March 31, 1917.
	Miles.	Miles	Miles
Township outlines	3,270	2,725	1,952
Section lines	7,100	7,524	5,745
Traverse	5,141	7,234	9,706
Resurvey	2,544	3,441	2,355
Total for season	18,055	20,924	19,758
Number of parties	59	53	41
Average miles per party	307	395	482

The number of parties, which, owing to the nature of their work, cannot be included in this statement is nine this year. The survey of the forty-one parties cost $535,024, the average cost per mile being $27.08 as compared with $30.05 in 1915.

OFFICE WORK.

FIRST DIVISION—GENERAL INFORMATION.

The work performed by this division consists, in general, of the answering of requests for information concerning surveys received from the general public and from other branches and departments, the issuing of all preliminary township plans, the entering of all survey returns in the various registers, the issuing of the annual report and other publications of the branch, and special work of various kinds such as the drafting of formal descriptions of land, etc.

Formerly the drafting of instructions for the surveyors in charge of parties in the field was carried on by this division, but a new division has now been formed under the charge of the Supervisor of Field Work and Accounts, and the drafting of instructions, has been taken over by them. The plans and sketches to accompany the instructions, however, are still prepared in this division. These show all information about the section lines already surveyed, as well as about any Indian or forest reserves, townsites, settlements, etc., which are located in the townships to be surveyed. About 3,000 of these plans and sketches are required each year.

The distribution of the publications issued by this branch, including plans, maps, and pamphlets is attended to by this division. The number distributed each year amounts to many thousands.

All returns from surveyors in the field are received here and are entered up in the various registers. They are then sent on to another division for examination and compiling, after which they are returned for the purpose of being placed on record.

Formal descriptions for insertion in land patents and licenses of occupation are drafted by this division, especially in cases where the boundaries of a parcel are very irregular and the descriptions consequently complicated.

Since the first Manual of Instructions for the Survey of Dominion Lands was issued in 1871 there have been many changes in the character of the boundary monuments erected at township, section, and quarter-section corners. The importance of having exact information in regard to such monuments cannot be over-estimated, both for the surveyors in the field engaged on resurveys and similar work, and for the office staff in dealing with the returns of old surveys. In the past such information was not readily available as it existed only in the old manuals of which very few are now to be had, and in the old departmental reports. A pamphlet has been prepared entitled "Description of Boundary Monuments Erected on the Survey of Dominion Lands, 1871-1917," giving complete information as to the character of all monuments used year by year on Dominion Land surveys since the beginning of the season of 1871. The pamphlet is fully illustrated and indexed, and will be of great value for office work. It should also be of material assistance to all surveyors engaged on surveys in the western provinces. It is now almost ready for the printers, and will probably be issued in about three months.

In addition to the annual report of the branch and the pamphlet on boundary monuments, two other publications were issued. One is the third edition of the pamphlet entitled "Description of the Surveyed Townships in the Peace River District in the Provinces of Alberta and British Columbia." The other publication, issued for the first time, is the "List of Maps and Publications Issued by the Topographical Surveys Branch and Available for Distribution."

The preparation of an index of the maps in the collection of the Geographic Board has been undertaken. These maps, more than 1,000 in number, include charts covering Canadian waters published by the British Admiralty, the Canadian Hydrographic Survey, the United States Lake Survey, the United States Coast and Geodetic Survey, and the French Admiralty; maps published by the Department of the Interior, the Geological Survey, the Department of Militia and Defence, the Provincial Governments; and maps from other sources.

The index will be in two different forms, one graphical and the other numerical. The first will consist of eleven sheets or maps about fifteen inches by twenty-one inches. These will show only the most important topographical features of the country, and will have the various maps plotted on them in the form of rectangles. Sheet No. 1 will be of the whole Dominion, on a scale of about 200 miles to an inch, and will show maps of which the largest dimension covers at least 400 miles. The other ten sheets which are on larger scales and which, combined, cover the whole Dominion, will show the smaller maps in the same manner. The numerical part of the index will contain a list of all these maps arranged according to the numbers assigned them on the graphical index, and giving for each map the title, publisher, size, scale, and the year of publication. The work is now well in hand, and will be ready for the printers in two or three months.

SECOND DIVISION—EXAMINATION OF RETURNS OF SURVEY.

The British Columbia surveys division having been merged into this division, the work now comprises the examination of the returns of survey of all Dominion lands, together with the preparation of all official plans thereof. It includes the examination of topographical and boundary surveys, of all mineral claim surveys, and of all plans of railways and provincial roads.

In the early part of the year the staff is engaged upon the examination of the surveys of the preceding year. In the summer and autumn, the surveyors' progress reports and the stadia surveyors' field notes and plots are received and examined. As in past years, a number of the stadia surveyors came into the office for about three months during the winter to assist with the preparation of the official township plans showing their work.

The official plans now indicate by what surveyor each monument was erected or last restored. This additional information adds greatly to the value of the plans but takes considerable time to procure. This is especially the case in the surveys in the railway belt in British Columbia which are often quite complicated, a large number of surveyors having worked within the area shown on a single official plan. In the past a small additional survey could be added to the previously compiled plan in a short time, but with the introduction of the new method it becomes necessary to investigate each monument shown on the previous plan, besides adding the new survey. As a result the number of plans completed this year, 795, is considerably less than in former years, although a large number of others are in various stages of preparation.

An arrangement has now been adopted whereby certain plans of survey of Dominion lands previously objected to by the Manitoba Land Titles Office may now be brought under the operation of the Real Property Act, and the patentees may obtain certificates of title.

The maps and report of the Commission for the survey of the boundary between Alberta and British Columbia were examined and prepared for publication. The report, which covers the work of four years, will be issued at an early date.

The maps of the Jasper Park, Crowsnest Forest, and Waterton Lakes Park Surveys were also examined and prepared for publication.

Another increasing part of the work is the preparation of special plans of quarter-sections for the Land Patents Branch. Cases arise where the plan of a township does not correctly show some particular quarter-section for which it is required to issue patent. It may not be feasible to issue a new township plan, but a plan of the particular quarter-section is compiled, sufficient copies being made by hand in the Drafting Division for attaching to the patent sent to the Registrar of the Land Titles Office, and to the copy of the patent registered in the department, as well as for those offices where the plans are necessary for reference.

A record of the mileage of the provincial road plans examined has been kept; it shows a mileage of 883 for the 576 plans examined. Owing to the unsatisfactory plans of the Battleford-Swift Current trail, surveyed for the most part before subdivision of the townships, it was in many cases impossible to determine through which quarter-sections the trail actually passed. The whole trail, 183 miles in length, has been re-plotted from the original field notes and from ties shown in the subdividers' field notes, with very gratifying results.

Railway plans to the number of seventy-five were examined, the total mileage being 861. The work on Yukon maps has been continued in the district north of Tantalus and west of Dawson.

The reports from the travelling inspectors on the personnel, organization, efficiency, and work of the survey parties are noted and where any recommendations are made concerning the conduct of the survey such recommendations are communicated to the surveyors.

Considerable time was devoted in co-operation with the inspector of surveys amending the method of subdivision of townships and the consequent revision of the Manual of Surveys, and to the design and preparation of new and suitable blank field books for the use of surveyors in the field.

THIRD DIVISION—DRAFTING.

In other divisions of the branch, returns of survey are examined and plans compiled. Naturally the compiler's chief concern is the collecting of accurate information, such matters as neatness, arrangement, lettering, and appearance being secondary. The work of the Drafting Division consists mainly in re-drawing these plans neatly for photographing for reproduction.

Additions have been made to the office equipment which greatly facilitates this work. They consist of a new tracing frame and a card index.

The tracing frame is larger than any previously used. The light is shut out by a curtain suspended from the ceiling in the form of a rectangle enclosing the frame, and leaving a clear space of about two feet on all sides of it. Above and below the curtain are open spaces to permit the air to circulate freely and give good ventilation. The advantages of this form of curtain over the hood type in which the curtain is quite close to the draftsman are apparent. The card index system has been adopted for recording township plans while being prepared for printing, and in connection with it a follow-up system traces the progress of all printing, through the various stages of drafting, photographing, proving, and printing.

The great majority of the plans drafted are plans of townships. To facilitate the work, printed forms of the roads, section numbers, and quarter-section lines of a regular township are used, requiring only the addition of the topography and the descriptive and numerical data. Townships, in part irregular, are re-drawn on a regular form printed in pale blue so that it is necessary for the draftsman to draw in black the regular part of the survey as shown in blue, and to depart from the standard blue form only where irregularities occur. The plans are reproduced by photography so that any of the blue form which has not been made black does not photograph.

At the end of last fiscal year there were 509 plans of townships on hand to be prepared for photographing. These have all been done, together with most of those received from the compilers during the year, so that we have now only 109 on hand. During the year 1,150 have been prepared, a number about 300 in excess of any previous year's work. This is accounted for by the clearing up of the large amount of work on hand at the beginning of the year.

Surveyors' sketch maps have been drawn and printed in the same way as last year, i.e. colours and symbols are used to describe the soil, timber, and other vegetation. The maps show the profiles along 960 miles of base lines surveyed, and the general character and topography of 654 townships or 23,544 square miles adjoining these lines.

The contour map of Jasper and vicinity, in four sheets on a scale of 1:10,000 or 6·336 inches to a mile with contour intervals of ten feet in the more level portions and twenty feet where slopes are steep, has been printed in four colours for office use. The map of Crowsnest Forest and Waterton Lakes park in five sheets, scale 1:62,500 or 1·014 inches to a mile with contour interval of 100 feet, is still with the printers but may be expected shortly. A third map of the central part of Jasper park in six sheets with scale and contour interval similar to the Crowsnest Forest map is also well under way. Astronomical Field Tables for use of Dominion Land Surveyors were prepared as in previous years, and also a number of such tables modified to suit the requirements of surveyors not operating on Dominion lands. Twenty-nine plans to accompany orders in council, eleven jobs of printing on the small Gordon press, twenty-three miscellaneous plans, and thirty-six other miscellaneous jobs were completed. The sectional maps are still distributed by one of the clerks of this division who also checks the stock from time to time so that the maps may be reprinted if necessary.

FOURTH DIVISION—MAPPING.

In the compiling room eight new sectional maps were prepared covering territory recently reached by base line surveyors. Three of these new sheets are in the region of lake Winnipeg and the other five are in northern Alberta. The area thus for the first time mapped with some degree of accuracy is about 30,000 square miles, being considerably larger than the province of New Brunswick. Revised editions were made of seventeen sheets and six others are in hand. The total number of sectional maps is now 128 covering an area of approximately 500,000 square miles.

In the surveys office at Calgary a scheme of contour lines is being worked out for all sectional maps covered by the network of base and meridian lines on which accurate levels have been taken. The contour interval is twenty-five, fifty, or one hundred feet, depending on the nature of the country. Five maps have been dealt with, three being new sheets and the other two revised editions. The contour lines will be shown in brown and will replace the hachures at present in use on the maps.

The method adopted two years ago of finding out the exact location of post offices and railway stations by sending diagrams to the postmasters, has been continued and with good results. Nine hundred and fifty diagrams of post offices on twenty sectional maps were sent out, and nine hundred and five were returned corrected.

Other work done in the office, but not directly connected with sectional maps, was as follows:—

(1) The surveyors' reports received from April 1, 1915, to March 31, 1916, were prepared and printed in five panphlets containing 170 pages. The preparation of reports for the year ended March 31, 1917, is well advanced.

(2) The sixth volume of reports of surveyors, being extracts from reports for townships 17 to 32, west of the Second meridian, is in hand, but progress is slow as only one man can be spared for the work and that for only part of the time.

(3) Parties employed on the survey of base and meridian lines penetrate far beyond all previous surveys and often reach districts of which very little is known. For this reason there is attached to every party an explorer whose duty it is to explore for twelve miles on each side of the line as the survey progresses. From the explorer's reports and sketches, combined with the returns of the survey of the line, a "sketch map" is made up showing the topography of the country along the line and for twelve miles on each side, with copious notes to indicate the kind of timber, the nature of the soil, etc. A scheme has been devised by which this information is shown by tints and symbols, and the notes which so tend to disfigure the maps have been reduced to a minimum. Three maps were worked out on this basis and accompany this report. They represent 568 miles of line run and cover an area of approximately 12,500 square miles.

(4) Eleven odd jobs were undertaken, the time required for each varying from one-half day to one week.

In the drafting room where the compiled maps are drawn for reproduction by photo-lithography one man has been engaged exclusively on maps of the Alberta-British Columbia boundary and the remainder on the sectional maps, preparing new sheets and revised editions for publication.

FIFTH DIVISION—SPECIAL SURVEYS.

Base Line Surveys.

Three parties were engaged in the survey of base lines. The required information for these surveys was prepared and the returns of survey are being examined. For several years past surveys of governing lines have been carried on within a fertile belt of twenty-seven million acres through which flow the lower waters of the Peace and Athabaska rivers. This block lies between the Fourth and Sixth meridians, and extends from township 88 to township 112. Surveys of governing lines in this block are now almost completed, four base line closings having been made therein during the past year. Of Dominion Lands surveys, those in this block are farthest north, the 29th base between the Fifth and Sixth meridians being 676 miles north of the international boundary, while the Sixth meridian has been produced to a point eighty-seven miles still farther north. Where the surveys have extended to such great distances there is danger of accumulations of error and consequent misplacement of monuments. Considerable care therefore has been exercised, and time spent in checking the records

of these surveys to ensure the establishment of monuments as nearly as possible in their correct latitudes. Some required adjustments in the positions of corners in this block were recommended, and these were made during the survey of the lines. The results of the surveys in this block are very satisfactory, monuments being very nearly in correct latitudes, and the majority of the closings agreeing very well with the computed values.

Some time was required for keeping the records of monuments erroneously established, computing the changes required for the correction of these, and registering when and by whom these corrections were made. Three surveyors received instructions for the correction of monuments originally placed in error.

Over 500 miles of old base lines and meridians were retraced during the year. The required information for these surveys was prepared and the returns of survey are being examined. These retracements were required in connection with the examination which is being made of old bases and meridians, and a report on this work is being prepared. No latitude observations with the zenith telescope were made during the year.

Astronomical Work.

Azimuth Observations.—All the azimuth observations taken on base lines and meridians during the summer season of 1915 and the winter season of 1915-16 have been received at this office and examined. This examination consisted of the checking of 1,275 individual observations on Polaris taken at 450 stations and controlling the bearings of over one thousand miles of original governing survey lines and seven hundred miles of retracement survey lines. The average length of line depending on a set of observations has during the past season been reduced to 3·8 miles. This fact is considered worthy of notice, especially when the speed at which the line is now produced is taken into consideration, as it necessitated the taking of a set of azimuth observations on almost every second day that the line was being produced. The following table gives a comparison of the results obtained during the season of 1915 with preceding years in triennial periods:—

	1909.	1912.	1915.
Average correction per mile of line..	5″·5	2″·1	1″·6
Miles of line per azimuth station...	4·3	4·5	3·8
Average number of observations per azimuth station.	1·6	2·6	2·8
Average range of observations at an azimuth station.	17″	9″	9″

This comparison shows that while very marked improvement took place in the earlier years of close supervision by this office over the work in the field, only a merely noticeable improvement has been obtained since. This fact would seem to indicate that further improvement in the work of the surveyor as regards azimuth observing and the accurate production of the line in bearing cannot reasonably be expected and indeed such improvement is not in any way necessary as the work now being done is considered well within the limits which practical considerations indicate as desirable.

Astronomical Field Tables.—The tables giving the right ascension and declination of the sun, and those tabulating the azimuth of Polaris were compiled and printed. A change in the latter was made to reduce somewhat their maximum error.

The general method of determining the azimuth of a line is to measure the angle between a mark on the line and one of the heavenly bodies, to compute the azimuth of the latter at that time, and from this to compute the azimuth of the line. For this purpose the tables of the Topographical Surveys were compiled, giving the azimuth of the Pole Star without any computation other than interpolation for latitude and time. The azimuth depends on the right ascension and declination of Polaris, the latitude of the place, and the hour angle of the star, the first two of which, in computing the tables, are considered constant, the other two variable. But this assumption is not strictly correct, and for a fixed latitude and time, the azimuth is varying

slightly from day to day. To assume a mean position of the star for a certain period produces an error, the magnitude of which depends on the period chosen. Some time ago, the position of the star during November and December, September and October, and July and August of three consecutive years was such that a mean position for this period introduced an error sufficiently small for the purpose of these tables, but gradually changes in the path of the star have caused this error to increase to such an extent that during the past year the grouping of months has had to be changed. The periods are now chosen in such a way as to give a minimum error for periods involving approximately six months, one set giving two months in each of three consecutive years, the other giving three months in each of two consecutive years. The arrangement is not as simple as the former one as it involves fractional months, but the maximum error has been decreased by about one-fifth. These new tables will be used after August, 1917.

Typical periods are:—

October 8 to December 14, 1916.
August 14 to October 6, 1917.
June 2 to August 9, 1918, and
December 15, 1917 to March 10, 1918.
March 9, 1919 to June 2, 1919.

Most surveyors and engineers in the past have dreaded azimuth determinations of any kind; observations were looked upon as a terrible ordeal, were dispensed with as much as possible, and were taken only when considered absolutely imperative. The two methods most commonly adopted for determining the azimuth of a line were by means of the sun and of Polaris at elongation. Observations by means of the sun have the great advantage that they are of course always taken in daylight and may be taken at almost any time in the summer months, except within say two hours of noon; they have the great disadvantage in that they are not very accurate, and the computations are long. The observation on Polaris at elongation is both easy to take, simple to compute and accurate in results, and land surveyors who desired accuracy in their work have adopted it almost universally in the past. It has the great disadvantage however, that, as elongation takes place only twice in twenty-four hours, the observation can be made at only two particular times of the day, and as one of these times is generally unsuitable on account of strong daylight and the consequent difficulty in seeing the star, in practice it generally happens that the observation can be made only once a day; if the weather conditions should, as may very likely happen, be unfavourable at that particular time the opportunity for observing is gone for another twenty-four hours. This is one of the main reasons why for some time back it has been the practice among an ever increasing number of surveyors and engineers to observe on Polaris at any time. The method, except when the star is close to upper or lower culmination is just as accurate as the elongation method but entails considerable computation. To overcome this, various forms of tables have been prepared. One form gives the azimuth with the hour angle and latitude as arguments, the declination being considered constant. A table of corrections for change in declination is also required. This form therefore requires the calculation of the hour angle from the watch time by means of a table giving the right ascension or the time of elongation by the star, double interpolation in the main table for hour angle and latitude, and a correction to this for change in declination, the last requiring also a table of declinations. Another form of table even less simple, is to compute the hour angle as above, interpolate in the table supplied for this value and for the year of the observation to obtain the approximate value of the azimuth, and interpolate in another table for this approximate azimuth and for the measured altitude to obtain a correction to the former. These tables are all arranged so as to be suitable for many years and are a great convenience over the actual computations, but the double interpolations and the various correction tables make them clumsy to use.

Frequent azimuth observations are one of the primary necessities for accurate work. Now if the taking of these observations can be made so simple and easy that surveyors will think nothing of them, a big step will have been made in raising the standard of survey work. About fourteen years ago the Surveyor General took the problem in hand. Transits were designed with telescopes sufficiently powerful to permit of the star being seen clearly in daylight and tables were issued by means of which the azimuth was derived in a much simpler manner than in the tables described above. They have been in general use on Dominion Lands surveys ever since and, taken in conjunction with the observing of Polaris in daytime, have been generally conceded among surveyors to have been one of the greatest, if not the very greatest, improvement ever made in Dominion Lands surveys.

Although the tables have been prepared for the Dominion Lands system of township surveys and are not very convenient for any other purpose, their use has been increasing for some years among surveyors and engineers other than those engaged on Dominion Lands surveys. Last year, the Minister of the Interior was requested by the Minister of Lands, Forests and Mines for Ontario, on behalf of the Ontario Land Surveyors Association, to issue astronomical field tables of the same kind, but modified to be convenient for these other Canadian surveyors and engineers. The preparation of the tables was authorized by the minister and five sets similar to those used on Dominion Lands surveys but extending from latitude 42° to 56° and having the latitude instead of the township as argument, have been computed.

MAGNETIC SURVEYS.

In 1916, fifty surveyors were instructed to observe for magnetic declination, and on the surveys of R. C. Purser, D.L.S., and E. S. Martindale, D.L.S., observations for magnetic dip and total force were taken at thirty-eight stations.

The data obtained during 1916, together with a discussion of all the magnetic data obtained to date, accompanied by various magnetic maps will be published in monograph form.

SURVEYING INSTRUMENTS.

All instruments used on surveys are required to be of approved pattern and in good condition.

A list of the instrumental equipment of the surveyors employed in the field was compiled, and where it was thought advisable the instruments were inspected and repaired.

Repairs were made to seventy-three transit theodolites, forty-three levels, four surveying aneroids, two dip circles, twenty-three levelling rods, fifty-one stadia rods, seven rod levels, and ten tripods.

Twenty sidereal watches were overhauled and readjusted.

In connection with the inspection of instruments and outfitting of the surveyors, 349 cases aggregating 8 tons (16,085 pounds), were shipped from this office and 214 cases aggregating 6½ tons (12,843 pounds), received.

A statement of instruments on hand on March 31, 1917, showing also the instruments purchased and sold during the year is given in Appendix 13 to this report.

GENERAL WORK.

A contract was let for the supply of 30,000 survey posts to be used in the field during 1916. The post consisted essentially of a thirty-inch length of standard one-inch pipe with a malleable iron foot-plate on the bottom and a bronze cap on the top—the bronze cap carrying the inscription PENALTY FOR REMOVAL, SEVEN YEARS IMPRISONMENT, and a crown. The completed post was then dipped in Mexican asphaltum, after

which it was filled with concrete consisting of equal parts of Portland cement and sand. The posts were packed in basswood crates holding ten posts each, for transportation purposes.

A representative from this division was deputed to oversee the manufacture of these posts, and this innovation resulted in work eminently satisfactory to both the manufacturer and the department.

Another contract has been let for 30,000 survey posts to be used in the field during 1917. The inscription on the bronze cap has been enlarged by the addition of the words DOMINION LANDS SURVEYS. Several improvements have been made in the design of the post, and the practice of deputing a representative to oversee the work has been continued.

Experiments have been made with the object in view of still further improving the design of these posts. The possibility of brazing on the bronze caps and welding on the foot-plates with the oxy-acetylene blow-pipe has been investigated, as has likewise the possibility of metal coating the outside of the post with zinc or copper to supersede the Mexican asphaltum at present in use.

A special short survey post for planting in rock has been designed and manufactured. In order to ascertain the best method of planting these posts, a piece of the hardest granite was obtained and the different surveyors in the city were invited to experiment for themselves and submit their opinions. As a result it would appear that little difficulty will be experienced in complying with the instructions which have been issued for planting these posts.

A special townsite post having a bronze cap on the top and a foot-plate on the bottom has been designed, the inscription on the cap being DOMINION LANDS SURVEYS.

All the surveyors in the field were circularized in regard to the best methods of planting and marking the standard survey posts. This has resulted in several improvements being effected.

A general review is being made of methods of rapidly solving the astronomical triangle for time-azimuths and altitude-azimuths, covering tables, solar attachment, calculating devices, abaci, nomograms, etc. This interesting matter is expected to be ready in the near future.

SURVEYS LABORATORY.

Complete tests were made of ten D.L.S. subdivision transits and seven clinometers. Partial tests were made of sixty-eight subdivision transits and fifteen levels. Twelve aneroid barometers were examined and a determination for index correction made; four aneroids were subjected to complete tests in accordance with the Bureau of Standards method, and certificates issued.

Tests were made for the War Purchasing Commission of Canada of thirty-three engineer's transits and twenty-three engineer's levels, and certificates issued for twenty-nine of the transits and twenty-three levels, the remaining four transits having been rejected.

Seventy-two sidereal watches were submitted for trial and sixty-six of these passed through complete tests; the remaining six stopped before the tests were finished. Five of the watches which stopped were repaired and later passed through complete tests. All watch tests are now made in accordance with the Bureau of Standards method for a class A certificate. Of the sixty-six watches completing the test, twenty-nine or forty-four per cent passed.

During the year one hundred and four stadia cards were computed, printed and issued to the surveyors.

The work done at the Surveys Laboratory is given in more detail in Appendix 12 of this report.

PHOTOGRAPHIC OFFICE.

Considerable time was spent reproducing the Crowsnest Forest Reserve and the interprovincial boundary maps which are printed in four colours. The black plates are

engraved on copper and transferred to zinc. The brown, blue, and red plates are photographed from the original drawing and printed direct on zinc.

A departure has been made from the ordinary practice in issuing the map of the central part of Jasper park in six sheets; the black has been carefully drawn by expert draftsmen and photographed direct for the press.

Photography is being used throughout for this map and the final results can hardly be distinguished from engraving.

The schedule in Appendix No. 3 shows an increase in the number of negatives over last year, caused by the large number of township plans issued during the latter part of the year.

Blue-print proofs from all negatives are now taken and if any errors are found correction is made on the negative before printing on zinc.

The amount of enlarging and printing was less than usual, due in a great measure to the falling off in photographic surveys.

Further experience with panchromatic dry plates which were tried out the previous season has proved them to be well adapted to photo-topographical surveying. The results obtained from these negatives both in the enlargements used for plotting purposes and the contact prints are all that can be desired.

A system which dispenses with much of the mounting of prints has been introduced. The small negatives are masked and printed on paper large enough for binding in covers, being made in this way into a loose-leaf album. While the saving in time is not great, the result is very neat and convenient.

GEOGRAPHIC BOARD.

The Geographic Board consists of eleven members appointed from the different departments at Ottawa and one member from each of the provinces. The secretary is an officer of the Department of the Interior.

The regular meetings of the board are held on the first Tuesday of every month, and all questions concerning geographic names in the Dominion which arise in the departments of the public service are referred to it. The names and orthography adopted by the board are to be accepted and used by all the departments in their publications.

The decisions of the board are published after each meeting in the *Canada Gazette* and also in bulletin form.

The report of the board is issued as a supplement to the report of the Department of the Interior. This report contains all decisions of the board since its inauguration and also its rules of nomenclature.

Besides attending to the correspondence of the board the secretary has prepared historical notes for a guide book to Jasper Park which will soon be published.

BOARD OF EXAMINERS FOR DOMINION LAND SURVEYORS.

The Board of Examiners for Dominion Land Surveyors held two meetings during the year.

The first was a special meeting lasting from May 1 to June 2 (inclusive), 1916, during which examinations were held at Ottawa, Toronto, Calgary, Edmonton, and Vancouver. The second was the regular annual meeting called for by section 9 of the Dominion Lands Surveys Act. It began on February 12, 1917, and lasted until March 15, 1917. During this meeting examinations were held at Ottawa, Toronto, Kingston, Calgary, Regina, Edmonton, and Vancouver. The total number of candidates for examination was 125. Of these 88 tried the preliminary examination, 35 tried the final examination and 2 tried the examination for Dominion Topographical Surveyor.

Twenty-nine candidates were successful at the preliminary examination, as follows:—

Bone, Allan Turner, Calgary, Alta.
Bush, Harold Frederick, Ottawa, Ont.
Donevan, Frederick James, Lansdowne, Ont.
Fetterly, Philip Austin, Calgary, Alta.
Fraser, John Donald, Ottawa, Ont.
Godwin, Dalton George, Ottawa, Ont.
Howe, John Parnell, Pembroke, Ont.
Johnston, George Wm. Frederick, Ottawa, Ont.
Lamert, Eugene, Montreal, Que.
Lawson, Horace Hetherington, Kingston, Ont.
Marchand, Eugene Francis, Ottawa, Ont.
Maddock, Charles Orville, Inwood, Ont.
Manning, Ralph Clarke, Hamilton, Ont.
Miller, William Harold, Ottawa, Ont.
McDonald, John Nicholson, Edmonton, Alta.
McDougall, John Lorne, Ottawa, Ont.
McGrath, Walter Neville, Ottawa, Ont.
McKenzie, Gordon Leslie, Ottawa, Ont.
Paterson, Elwin L., Rocklyn, Ont.
Petrie, Edward Archibald, Ottawa, Ont.
Philip, Patrick, Vancouver, B.C.
Quinn, James John, Ottawa, Ont.
Raynard, Kenneth S., Ottawa, Ont.
Russell, Benjamin, Ottawa, Ont.
Samuel, Maxwell, Toronto, Ont.
Snell, Charles Henry, Red Deer, Alta.
Watson, Cyril James, Ottawa, Ont.
Whittier, Albert Ronald, Ottawa, Ont.
Wrong, Gordon, Sandwich, Ont.

Twenty-three candidates were successful at the final examination, as follows:—

Atkins, Cecil Benjamin, Revelstoke, B.C.
Beale, Alfred Martin, Ottawa, Ont.
Bruynseraede, Rene Paul, Edmonton, Alta.
Christie, Gerald Moffatt, Ashcroft, B.C.
Coursier, Eric Clarence, Revelstoke, B.C.
Daly, William Patrick, Ottawa, Ont.
Disney, John Harold, Edmonds, B.C.
Flook, Samuel Evert, Port Arthur, Ont.
Hunt, Septimus, Calgary, Alta.
Joslyn, Cecil Earle, Sintaluta, Sask.
Lamarque, Ernest Charles Wm., Marine Heights, B.C.
Matheson, Alexander, Lorne, Ont.
Martin, Walter Harold, Toronto, Ont.
Meikle, MacKay, Ottawa, Ont.
Moffatt, William James, Vancouver, B.C.
McGugan, Donald Johnston, New Westminster, B.C.
Novion, Leon Marie Lucien, Edmonton, Alta.
Perry, Alfred Melville, Ottawa, Ont.
Rimmer, William Bolton, Vancouver, B.C.
Russell, John, Edmonton, Alta.
Spence, William A., Ottawa, Ont.
Tassie, Gilbert Culloden, Vancouver, B.C.

Twenty-three commissions were issued to candidates who had passed the final examination, and had furnished oaths of office and allegiance and bonds for the sum of one thousand dollars as required by section 25 of the Dominion Lands Surveys Act.

Seventeen certificates of preliminary examination were issued to successful candidates who had complied with the requirements of the law.

Section 35 of the Dominion Lands Surveys Act provides that every Dominion Land Surveyor shall be in possession of a subsidiary standard of length. During the year six new standards were issued to surveyors. One Ontario Land Surveyor, who was also a Dominion Land Surveyor, sent his O.L.S. standard measure to be tested. This measure was found to be in good condition, and after being tested at the Surveys Laboratory was re-issued as a subsidiary standard of length. One standard measure was issued to the Secretary of the Saskatchewan Land Surveyors' Association for one of the members. One D.L.S. standard measure was tested at the laboratory.

APPENDICES.

No. 1. Schedule of surveyors employed and work executed by them.
No. 2. Schedule showing for each surveyor employed the number of miles surveyed of section lines, township outlines, traverses of lakes and rivers, and resurvey; also the cost of the same.
No. 3. Details of office work.
No. 4. Inspection Surveys.
No. 5. Base line Surveys.
No. 6. Subdivision Surveys.
No. 7. Railway Belt Surveys.
No. 8. Stadia Surveys.
No. 9. Miscellaneous Surveys.
No. 10. Yukon Surveys.
No. 11. Levelling.
No. 12. Report of Surveys Laboratory.
No. 13. List of surveying instruments on hand March 31, 1917.

MAPS AND PROFILES.

The following maps accompany this report:—

1. Map to illustrate progress of Dominion Land Surveys to March 31, 1917.

2. Map showing topography and profiles of base lines and meridians run during the year.

E. DEVILLE,
Surveyor General.

SCHEDULES AND STATEMENTS.

APPENDIX No. 1.

SCHEDULE of Surveyors employed and work executed by them.

Surveyor.	Address.	Description of Work.
Akins, J. R.	St. Catharines, Ont.	Survey of the following base lines west of the Fifth meridian: the 24th and 25th bases across ranges 22 to 25; the 26th base across ranges 21 to 25; and the 28th base across ranges 19 to 24. Survey of the following base lines west of the Sixth meridian; the 24th base across ranges 1 and 2; the 25th base across ranges 1 to 3; the 26th base across ranges 1, 2, and part of 3; the 27th base across ranges 1 to 3; the 28th base across ranges 1 and 2; and the 29th base across ranges 1 to 6.
Aylsworth, C. F.	Madoc, Ont.	Resurvey in tps. 17 and 18-19-Pr.; tp. 38-28-Pr.; and tps. 37 and 38-29-Pr. Traverse in tps. 17 and 18-18-Pr.; and tp. 18-20-Pr.
Baker, J. C.	Kingston, Ont.	Subdivision of tp. 92-22-5; tps. 92 and 93-23-5; and tp. 89-26-5. Part subdivision of tp. 91-23-5; tp. 93-24-5; and tp. 89-25-5. Survey of the east outlines of tp. 90-25-5; and tp. 90-26-5.
Bennett, G. A.	Tillsonburg, Ont.	Stadia surveys in tps. 31, 32, 33, 34, and 35-1-3; 31, 32, 33, 34, 35, and 36-2-3; tps 31, 32, 33, and 34-3-3; tps. 31, 32, 33, 34, and 35-4-3; tps. 32, 33, 34, 35, 36, and 37-5-3; tps. 31, 32, 33, 34, 35, 36, and 37-6-3; tps. 31, 32, 33, 34, 35, 36, and 37-7-3; tps. 30, 31, 32, 33, 34, 35, 36, and 37-8-3; tps. 31, 32, 33, 34, 35, 36, and 37-9-3; tps. 31, 32, 33, 34, 35, 36, 37, and 38-10-3; tps. 31, 32, 33, 34, 35, 36, 37 and 38-11-3; tps. 33, 35, 36, 37, and 38-12-3; and tps. 36, 37, and 38-13-3.
Blanchet, G. H.	Ottawa, Ont.	Survey of the 19th base line across ranges 18 to 27; and the 20th base line across ranges 10 to 26, west of the Third meridian.
Boulton, W. J.	Wallaceburg, Ont.	Stadia surveys in tps. 15, 17, 18, and 19-13-4; tps. 17, 18, and 19-14-4; tps. 15, 16, 17, 18, and 19-15-4; tps. 15, 16, 18, and 19-16-4; tps. 15, 16, 17, 18, 19, and 20-17-4; tps. 15, 17, 18, 19, and 20-18-4; tps. 15, 16, 18, and 19-19-4; tps. 15, 17, and 19-20-4; tps. 14, 15, 16, 17, and 19-21-4; tps. 14, 15, 18, and 19-22-4; tps. 16 and 17-23-4; tp. 16-24-4; tps. 15, 17, and 18-25-4; tps. 15, 16, 18, and 19-26-4; tps. 15, 16, 17, and 19-27-4; tps. 14, 16, 17, 18, and 19-28-4; tps. 15, 16, 17, and 19-29-4; and tps. 15, 16 and 17-30-4. Retracement in tp. 16-13-4; tps. 15 and 16-14-4; tp. 17-16-4; tp. 16-18-4; tp. 17-19-4; tps. 16 and 18-20-4; tp. 18-21-4; tps. 16 and 17-22-4; tps. 15, 18, and 19-23-4; tps. 15, 17, 18, and 19-24-4; tps. 16 and 19-25-4; tp. 17-26-4; tp. 18-27-4 and tp. 15-28-4.
Bowman, E P.	West Montrose, Ont.	Stadia surveys in tps. 46 and 47-14-3; tps. 45, 46, 47, 48, 49, and 50-15-3; tps. 46, 47, 48, 49, and 50-16-3; tps. 47, 48, 49, and 50-17-3; tps. 45, 46, 47, 48, 49, and 50-18-3; tps. 45, 46, and 47-19-3; tps. 45, 46, 47, 48, 50, and 51-20-3; tps. 46, 47, 48, 49, and 50-21-3; tps. 46, 47, 48, 49, 50, and 51-22-3; tps. 46, 47, 48, 49, and 50-23-3; and tps. 46, 47, 48, 49 and 50-24-3. Retracement in tp. 51-21-3; and tp. 51-24-3.

SESSIONAL PAPER No. 25b

SCHEDULE of Surveyors employed and work executed by them—*Continued.*

Surveyor.	Address.	Description of Work.
Brenot, L.	Ottawa, Ont.	Subdivision of tp. 84-15-6; tps. 83 and 84-16-6; and tp. 81-17-6. Part subdivision of tp. 82-16-6; and tp. 82-17-6. Survey of the east outlines of tp. 81-16-6; and tp. 82-17-6.
Brownlee, J. H.	Dawson, Y.T.	Mineral claim, base line, and miscellaneous surveys in the Yukon Territory.
Buchanan, J. A.	Edmonton, Alta.	Subdivision of tps. 93 and 94-20-5; and tp. 93-21-5. Part subdivision of tps. 95 and 97-19-5; tps. 95, 96, and 97-20-5; and tp. 94-21-5. Survey of the east outlines of tps. 93 and 96-19-5; and the north outline of tp. 93-19-5. Traverse in tp. 94-19-5.
Calder, J. A.	Lytton, B.C.	Subdivision in tp. 22-20-6; tps. 22, 23, and 24-21-6; tps. 22 and 23-22-6; tp. 23-25-6; tp. 23-26-6; tps. 21 and 22-27-6; and tps. 19 and 20-28-6. Traverse in tp. 22-21-6.
Cautley, R. W.	Edmonton, Alta.	Survey of interprovincial boundary between Alberta and British Columbia in Palliser pass; White Man pass; and Assiniboine pass.
Christie, W.	Prince Albert, Sask.	Subdivision of tp. 57-22-2; and tps. 55, 56, and 57-23-2. Part subdivision of tps. 54 and 55-22-2, and tp. 54-23-2. Survey of the east outline of tp. 56-22-2. Traverse in tp. 57-21-2; tp. 58-22-2; and tp. 54-24-2.
Coté, J. M.	Ottawa, Ont.	Miscellaneous subdivision in tps. 31 and 46-12-2; tp. 41-13-2; tp. 37-14-2; tp. 39-15-2; tp. 39-18-2; tps. 31 and 32-28-2; tp. 31-12-3; tp. 33-13-3; tps. 32 and 33-15-3; tp. 33-16-3; tp. 36-18-3; tps. 30, 39, 40, and 49-19-3; tps. 34, 35, 38, and 40-20-3; tps. 31 and 32-24-3; tp. 32-25-3; and tp. 32-26-3. Resurvey in tps. 41 and 42-23-2; tps. 46 and 47-1-3; tps. 45 and 46-2-3; tp. 34-5-3 and tp. 50-25-3. Retracement surveys in tp. 26-9-2; tps. 26 and 27-10-2; tp. 38-22-2; tp. 38-23-2; tp. 41-24-2; tps. 45, 45A, 46 and 47-27-2; tp. 30-28-2; tp. 31-29-2; tp. 48-1-3; tp. 31-16-3; tp. 36-17-3 and tp. 33-20-3. Restoration surveys in tps. 46A and 47-26-2, and tp. 34-12-3. Correction surveys in tp. 34-6-3; and tp. 41-13-3. Lot survey in tp. 44-7-4.
Cowper, G. C.	Welland, Ont.	Stadia surveys in tps. 22 and 33-4-4; tps. 22, 29, 31, 32, 33, and 34-5-4; tps. 22, 27, 28, 29, 30, 31, 32, and 33-6-4; tps. 22, 28, 29, 30, 31, 32, and 33-7-4; tps. 22, 25, 28, 29, 30, 31, 32, and 33-8-4; tps. 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, and 34-9-4; tps. 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, and 34-10-4; tps. 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, and 34-11-4; tps. 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, and 34-12-4; tps. 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, and 33-13-4; tps. 25, 28, 32, and 33-14-4; tps. 33 and 34-15-4; tps. 33 and 34-16-4; and tps. 33 and 34-17-4.
Davies, T. A.	Edmonton, Alta.	Stadia surveys in tps. 37, 41, and 42-28-3; tp. 37-29-3; tps. 37, 38, 39, 40, 41, 42, and 43-1-4; tps. 38, 39, 40, and 41-2-4; tps. 38, 39, 40, 41 and 42-3-4; tps. 36, 37, 38, 39, 40, 41, 42, and 43-4-4; tps. 36, 37, 38, 39, 40, 41, 42, and 43-5-4; tps. 38, 40, 41, 42, and 44-6-4; tps. 37, 38, 39, 40, 41, 42, and 44-7-4; tps. 38, 39, 40, 41, and 42-8-4; and tp. 39-9-4.
Deans, W. J.	Brandon, Man.	Subdivision in tps. 58 and 65-2-Pr.; tps. 57, 58 and 65-3-Pr; and tp. 57-4-Pr. Survey of Elk island in tps. 20 and 21-7-E; Lot surveys at Birch River station in tp. 39-26-Pr; and at Norway House in tp. 57-3-Pr. and tp. 57-4-Pr.

SCHEDULE of Surveyors employed and work executed by them—*Continued.*

Surveyor.	Address.	Description of Work.
Evans, S. L.	Corinth, Ont.	Subdivision in tps. 19 and 20-4-3; tp. 19-5-3; tp. 74-5-5; and tp. 74-6-5. Retracement in tp. 18-24-2; tps. 18 and 19-25-2; tps. 18 and 19-3-3; tps. 17 and 18-4-3; tps. 18 and 32-5-3; tps. 15 and 16-6-3; tps. 18 and 19-8-3; tps. 17, 18 and 19-9-3; tp. 17-10-3; tp. 18-11-3; tp. 17-14-3; tp. 14-16-3; tps. 19 and 20-17-3; tp. 21-18-3; tp. 56-3-4; tp. 57-9-4; tp. 57-10-4; tp. 59-11-4; tps. 59 and 61-12-4; and tp. 60-18-4. Resurvey in tp. 21-9-3; tps. 19 and 20-14-3; tps. 19 and 20-16-3; tp. 12-17-3; tp. 22-18-3; and tps. 13, 14, and 15-19-3. Correction in tp. 19-22-2. Traverse in tp. 60-6-4; tp. 58-9-4; and tp. 59-11-4. Examination of subdivision surveys made during the season by J. C. Baker, D.L.S.
Fawcett, S. D.	Ottawa, Ont.	Subdivision of tp. 79-17-6; tps. 78 and 79-18-6; and tp. 79-19-6. Part subdivision of tp. 80-17-6; and tps. 77 and 80-18-6. Survey of the east outlines of tps. 77, 78, and 80-20-6. Traverse in tp. 80-19-6.
Fletcher, J. A.	Fletcher, Ont.	Survey of the 29th base line across ranges 7 to 24; and the 30th base line across ranges 8 to 16 and part of range 17, west of the Fourth meridian. Survey of the east outlines of tps. 113, 114, 115, and 116-8-4.
Fontaine, L. E.	Lévis, P.Q.	Subdivision in tp. 41-18-5; and tp. 48-24-5. Correction survey in tp. 50-19-4; and tp. 40-27-4. Retracement survey in tp. 12-19-4; tp. 49-22-4; tp. 1-26-4; tp. 51-27-4; tps. 20, 21, and 28-29-4; tps. 21 and 50-1-5; and tps. 50 and 52-2-5. Traverse in tp. 57-23-4; tps. 23 and 24-24-4; tp. 53-1-5; tp. 58-4-5; tp. 58-6-5; and tp. 26-7-5. Investigation of section lines in tp. 11-1-5. Marking monuments in tp. 24-1-5. Preliminary lot survey in tp. 29-20-4.
Galletly, J. S.	Oshawa, Ont.	Subdivision survey in tp. 55-28-Pr; tp. 55-29-Pr; and tp. 55-30-Pr. Survey of road in tp. 55-27-Pr; and tp. 55-28-Pr. Survey of Carrot River settlement in tp. 55-29-Pr; and of timber berth No. 920 in tp. 55-29-Pr; and tp. 55-30-Pr.
Glover, A. E.	Edmonton, Alta.	Subdivision of tp. 75-25-5; tp. 75-26-5; and tps. 75 and 76-3-6. Part subdivision of tps. 74 and 75-24-5; and tp. 74-26-5. Survey of the east outlines of tps. 74 and 76-25-5; tps. 74 and 76-26-5; and part of tp. 74-3-6.
Jackson, J. E.	Hamilton, Ont.	Subdivision of tp. 32-5-E; tps. 30, 31, and 32-6-E; and tps. 28, 29, and part of 30-7-E. Traverse in tps. 27 and 31-7-E; and tps. 27 and 28-8-E. Retracement of I. R. in tp. 32-7-E.
Johnston, J. H.	Peace River, Alta.	Subdivision of tp. 86-16-5; tp. 86-17-5; tps. 82, 85 and 86-18-5; tp. 88-19-5; and part of tp. 87-19-5. Survey of the east outlines of tps. 85-87, and 88-16-5; tps. 85, 87, and 88-17-5; and tps. 83, 84, 87, and 88-18-5.
Johnston, W. J.	St. Catharines, Ont.	Subdivision in tp. 21-28-5; tps. 20 and 21-29-5; tps. 20, 21 and 22-1-6; tps. 22, 23 and 24-2-6; tp. 23-3-6; and tps. 21 and 22-7-6. Traverse in tps. 21 and 22-1-6; tp. 23-2-6; tp. 23-3-6; and tps. 21 and 22-7-6.

SESSIONAL PAPER No. 25b

SCHEDULE of Surveyors employed and work executed by them—*Continued.*

Surveyor.	Address.	Description of Work.
King, J. A. S.	Ottawa, Ont.	Subdivision in tps. 3 and 4-7-Pr.; tps. 3 and 4-8-Pr.; tps. 16 and 17-10-Pr.; tps. 15, 16, 17, and 18-11-Pr.; tps. 3 and 4-21-Pr.; tps. 3 and 4-22-Pr.; tp. 43-26-Pr.; tp. 44-27-Pr.; tp. 44-28-Pr.; and tp. 44-29-Pr.; Retracement survey in tp. 40-23-Pr.; tp. 28-29-Pr.; tp. 29-29A-Pr.; tp. 10-2-2; tp. 11-3-2; and tp. 11-4-2. Correction survey in tp. 10-5-2. Traverse in tp. 41-23-Pr.; and tp. 40-24-Pr. Investigation of Big Grass marsh in tps. 15 and 18-10-Pr.
Knight, R. H.	Edmonton, Alta.	Subdivision of tp. 82-6-4. Part subdivision of tp. 84-5-4; tps. 79, 80, 81, 83, and 84-6-4; and tps. 78, 79, 80, 81, 85, and 86-7-4. Traverse in tps. 76, 77, 83, and 84-7-4; tps. 75, 76, and 77-8-4; tps. 73, 74, and 75-9-4; and tps. 73 and 74-10-4.
LeBlanc, P. M. H.	Ottawa, Ont.	Subdivision of tp. 57-29-Pr. Part subdivision of tps. 54 and 55-20-Pr.; tp. 56-21-Pr.; tp. 57-27-Pr.; tp. 57-28-Pr.; and tp. 58-29-Pr. Survey of the east outlines of tp. 53-20-Pr.; tp. 53-21-Pr.; and part of tp. 56-20-Pr. Retracement of part of I.R. No. 31B, and survey of I.R. No. 31F in tp. 54-19-Pr. Traverse of road between Barrier and Sturgeon lakes.
Lighthall, A.	Vancouver, B.C.	Subdivision of tp. 79-1-6; tp. 79-2-6; and tp. 80-7-6. Part subdivision of tps. 77 and 78-1-6; tps. 77 and 78-2-6; tp. 77-3-6; tps. 79 and 80-6-6; and tps. 78 and 79-7-6. Survey of the east outline of tp. 80-5-6.
Lonergan, G. J.	Buckingham, P.Q.	Inspection of contract No. 10 of 1914. Inspection of subdivision parties under Messrs. J. C. Baker, D.L.S.; A. E. Glover, D.L.S.; A. Lighthall, D.L.S. and D. F. McEwen, D.L.S. Inspection of railway belt survey parties under Messrs. N. C. Stewart, D.L.S.; W. J. Johnston, D.L.S.; C. H. Taggart, D.L.S.; J. A. Calder, D.L.S.; and R. B. McKay, D.L.S. Inspection of stadia survey parties under Messrs. G. A. Bennett, D.L.S.; E. P. Bowman, D.L.S.; W. J. Boulton, D.L.S.; G. C. Cowper, D.L.S.; T. A. Davies, D.L.S.; C. Rinfret, D.L.S.; and H. M. R. Soars, D.L.S.
Martindale, E. S.	Aylmer, Ont.	Subdivision in tp. 10-3-2. Retracement survey in tp. 11-6-2; tp. 3-16-2; tp. 11-17-2; tp. 3-19-2; tp. 20-29-2; tp. 20-1-3; tp. 11-6-3; tp. 17-7-3; tp. 22-8-3; tps. 15, 17, and 18-9-3; tps. 12 and 13-1-4; and tp. 22-9-4. Correction survey in tps. 15 and 16-2-3; tp. 19-3-3; tp. 16-4-3; tp. 15-5-3; tp. 18-6-3; tp. 16-8-3; tp. 18-11-3; and tp. 16-1-4. Restoration survey in tp. 11-23-2; and tp. 32-1-4. Investigation of monuments in tp. 17-5-3; and tp. 20-9-3. Traverse in tp. 11-2-2; tp. 9-3-2; tp. 21-23-3; tps. 5 and 6-29-3; tp. 19-28-4; and tp. 19-29-4. Survey of reservoir site in tp. 6-21-3. Survey of cemetery at Banff, and correction in St. Julien addition to the townsite of Banff. Preliminary survey of Drumheller townsite in tp. 29-20-4.
McEwen, D. F.	Edmonton, Alta	Subdivision of tps. 69, 70, and 71-19-5; tps. 69 and 70-20-5; and tp. 69-21-5. Part subdivision of tps. 71 and 72-18-5. Traverse in tp. 72-19-5; and tp. 68-21-5.
McGarry, P. J.	Merritton, Ont.	Subdivision in tp. 58-7-3; tps. 57, 58, 59, and 60-8-3; tps. 57, 59, and 60-9-3; and tps. 59 and 60-10-3.

SCHEDULE of Surveyors employed and work executed by them—*Continued.*

Surveyor.	Address.	Description of Work.
McKay, R. B.	Vancouver, B.C.	Subdivision in tps. 1, 2, and 5-26-6; tps. 1, 2, 3, and 4-27-6; tp. 4-28-6; tps. 3 and 4-29-6; tp. 3-20-6; tp. 4-5-7; tps. 20, 21, 24, and 42 E. C. M.; and tp. 2 W.C.M. Traverse in tp. 1-26-6; tps. 1, 2, 3, and 4-27-6; tp. 4-28-6; tp. 3-30-6; tp. 4-5-7; and tps. 21, 24, and 42 E. C. M.
McKnight, J. H.	Simcoe, Ont.	Stadia surveys in tp. 42-17-2; tps. 41, 42, 43, 44, and 45-18-2; tps. 39, 40, 41, 42, 43, 44, and 45-19-2; tps. 38, 39, 40, 41, 42, 43, 44, 45, and 46-20-2; tps. 38, 39, 40, 41, 43, 44, 45; and 46-21-2; tps. 44 and 45-21A-2; and tps. 40, 45, 45A, and 46-22-2.
Narraway, A. M.	Ottawa, Ont.	Inspection of base line parties under Messrs. J. R. Akins, D.L.S.; J. A. Fletcher, D.L.S.; and A. G. Stuart, D.L.S.; Inspection of subdivision parties under Messrs. J. A. Buchanan, D.L.S.; W. Christie, D.L.S.; J. H. Johnston, D.L.S.; P. J. McGarry, D.L.S.; J. W. Pierce, D.L.S.; and J. E. Jackson, D.L.S. Inspection of miscellaneous survey parties under Messrs. S. L. Evans, D.L.S., J. M. Coté, D.L.S.; C. F. Aylsworth, D.L.S.; J. A. S. King, D.L.S.; P. M. H. LeBlanc, D.L.S.; and J. S. Galletly, D.L.S.; Inspection of stadia survey parties under Messrs. P. E. Palmer, D.L.S.; W. A. Scott, D.L.S.; and C. M. Walker, D.L.S.
Norrish, W. H.	Ottawa, Ont.	Subdivision of tp. 53-13-2; tp. 53-14-2; and tp. 53-15-2. Part subdivision of tp. 53-12-2; tp. 54-14-2; and tp. 54-15-2. Traverse in tp. 52-12-2; tp. 52-13-2; tp. 52-14-2; tp. 52-15-2; and tp. 54-16-2.
Palmer, P. E.	Ottawa, Ont.	Stadia surveys in tps. 25, 26, 27, 28, 29, 30, and 31-2-3; tps. 25, 26, 27, 28, 29, 30, and 31-3-3; tps. 25, 26, 27, 28, 29, and 30-4-3; tps. 23, 24, 25, 26, 27, 28, 29, 30, 31, and 32-5-3; tps. 23, 24, 25, 26, 27, 28, 29, and 30-6-3; tps. 23, 24, 25, 26, 27, 28, 29, and 30-7-3; tps. 20, 21, 22, 23, 25, 26, 27, 28, 29, 30, and 31-8-3; tps. 20, 21, 22, 23, and 28-9-3; tps. 20, 21, 22, 23, 24, and 25-10-3; tps. 19, 20, 21, 22, 23, 24, and 25-11-3; tps. 18, 19, 20, 21, 22, 23, 24, and 25-12-3; and tps. 19, 20, 21, 22, and 23-13-3.
Pierce, J. W.	Pembroke, Ont.	Subdivision of tps. 98, 99, 100, and 101-19-5. Part subdivision of tps. 98 and 99-18-5; and tps. 98, 100, and 101-20-5. Survey of the east outlines of tp. 97-19-5; tp. 97-20-5; and tp. 97-21-5.
Plunkett, T. H.	Meaford, Ont.	Retracement surveys in tps. 4 and 12-9-E.; tp. 1-10-E.; tp. 23-1-Pr.; tp. 22-6-Pr.; tp. 17-20-Pr.; tp. 6-25-Pr.; tp. 39-26-Pr.; tp. 23-27-Pr.; tp. 28-29-Pr.; tp. 23-30-Pr.; tps. 12 and 21-31-Pr.; and tp. 23-32-Pr.; Traverse in tp. 23-1-Pr.; tp. 30-9-Pr.; tp. 17-19-Pr.; tp. 17-20-Pr.; and tp. 28-29-Pr. Subdivision at Bedford Station in tp. 5-9-E.; at Menisino in tp. 1-10-E.; and at Birch River in tp. 39-26-Pr.
Purser, R. C.	Ottawa, Ont.	Subdivision in tps. 36 and 37-4-4; and tp. 36-5-4. Resurvey in tp. 24-2-2; tps. 23 and 24-3-2; tp. 19-11-2; and tps. 10 and 49-5-3. Retracement in tp. 32-1-2; tp. 23-3-2; tp. 30-6-2; tp. 30-17-2; tp. 32-26-2; tp. 29-27-2; tp. 50-28-2; and tp. 39-12-3. Correction survey in tp. 29-32-Pr.; tp. 21-6-2; tp. 38-13-2; tp. 28-16-2; tps. 27 and 43-17-2; tp. 46-20-2; tp.

SESSIONAL PAPER No. 25b

SCHEDULE of Surveyors employed and work executed by them—*Continued.*

Surveyor.	Address.	Description of Work.
Purser, R. C.	Ottawa, Ont.—*Con.*	27-24-2; tp. 51-25-2; tp. 38-26-2; tps. 28 and 42-27-2; tp. 38-10-3; tp. 51-15-3; tp. 52-17-3; tp. 42-24-3; tp. 42-25-3; tp. 42-4-4; and tp. 35-19-4. Restoration survey in tps. 27 and 28-26-2. Investigation in tp. 46-3-3. Erection of monuments in tp. 32-1-3. Traverse in tp. 49-27-2; and tp. 29-21-4. Survey of Doukhobor cemeteries in tp. 30-5-2. Lot resurvey in tp. 43-1-3.
Rinfret, C.	St. Stanislas, P.Q.	Stadia surveys in tps. 9, 10, and 17-24-2; tps. 9, 10, 11, 12, 13, 14, 15, and 16-25-2; tps. 10, 11, 12, 13, 14, 15, and 16-26-2; tps. 8, 9, 10, 11, 14, 15, and 16-27-2; tps. 8, 9, 10, 11, 14, 15, and 16-28-2; tps. 8, 9, 10, 11, 12, and 15-29-2; tps. 9, 10, and 11-30-2; tps. 7, 8, 9, 10, 11, and 12-1-3; tps. 7, 8, 9, 10, 11, 12, 13, and 14-2-3; tps. 7, 8, 9, 10, 11, 12, 13, and 14-3-3; tps. 7, 8, 9, 10, 11, 12, 13, and 14-5-3; tps. 7, 8, 9, 10, 11, 12, 13, and 14-6-3; and tps. 7, 8, 9, 10, 11, 12, 13, and 14-7-3.
Scott, W. A.	Galt, Ont.	Stadia surveys in tp. 15-15-E; tps. 17, 18, and 19-14-2; tps. 17, 18, 19, and 20-15-2; tps. 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 27A, and 28-16-2; tps. 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, and 29-17-2; tps. 17, 18, 19, 21, 22, 23, 24, 25, 26, 27, and 28-18-2; tps. 17, 18, 19, 20, 21, 22, 24, 27, 28, and 29-19-2; tps. 17, 18, 19, 21, 22, 23, 24, 25, 26, 27, and 28-20-2; tps. 17, 18, 19, 20, 22, 23, 24, 26, 27, 28, and 29-21-2; tps. 17, 19, 22, 23, 26, 27, 28, and 29-22-2; tps. 22, 26, 27, and 28-23-2; tp. 27-24-2; and tp. 28-25-2.
Seibert, F. V.	Edmonton, Alta	Subdivision of tp. 65-6-4; tp. 65-7-4; tps. 65 and 66-8-4; and tps. 65 and 66-9-4. Part subdivision of tp. 66-6-4; and tp. 66-7-4. Survey of the east outlines of tps. 67 and 68-8-4. Traverse in tp. 64-9-4.
Soars, H. M. R.	Edmonton, Alta	Stadia surveys in tps. 46, 47, 48, and 49-15-4; tps. 46, 47, 48, and 49-16-4; tps. 44, 45, 46, 47, 48, and 49-17-4; tps. 44, 45, 46, 47, 48, and 49-18-4; tps. 45, 46, 47, 48, and 49-19-4; tps. 45, 46, 47, 48, and 49-20-4; tps. 45, 46, 47, and 48-21-4; tps. 44, 45, 46, 47, and 48-22-4; tps. 44, 45, 46, and 47-23-4; and tp. 46-24-4.
Stewart, N. C.	Vancouver, B.C.	Subdivision in tp. 29-23-5; tps. 28 and 29-29-5; tps. 23, 24, and 28-1-6; and tps. 23 and 24-2-6. Traverse in tp. 29-23-5; tp. 24-1-6; and tps. 24, 25, 26, and 27-2-6. Townsite correction survey at Golden.
Stuart, A. G.	Winnipeg, Man.	Rétracement survey of the Third meridian from the international boundary to township 48; and the 14th base line from the east boundary of range 22 west of the Third meridian, to the Fifth meridian. Miscellaneous retracement in tp. 12-28-2; tp. 11-30-2; and tp. 12-1-3.
Taggart, C. H.	Kamloops, B.C.	Subdivision in tp. 21-11-6; tps. 21 and 22-12-6; tps. 23 and 24-14-6; tps. 21, 22, 23, and 24-15-6; tps. 20 and 21-16-6; and tp. 17-17-6. Traverse in tp. 22-12-6; tp. 20-16-6; and tp. 17-17-6.
Walker, C. M.	Ottawa, Ont.	Stadia surveys in tps. 36 and 37-22-2; tps. 34, 35, 36, and 37-23-2; tps. 33, 34, 35, 36, and 38-24-2; tps. 33, 34, 35, 36, and 38-25-2; tps. 33, 34, 35, 36, 37, 38, and 40-26-2; tps. 34, 35, 36, 39, 40, 41, 42, and 43-27-2; tps. 34, 35, 36, 37, 38, 39, and 40-28-2; tps. 34, 35, 36, and 37-29-2; and tps. 35, 37, 40, and 47-1-3.

SCHEDULE of Surveyors employed and work executed by them—*Concluded.*

Surveyor.	Address.	Description of Work.
Wallace, J. N..	..Calgary, Alta.	..Lines of levels along Hudson Bay railway from Mile 100 to Mile 241; along Canadian Northern railway from Rosebud to Calgary; along Edmonton Dunvegan and British Columbia railway from Edmonton to Sawridge; along Alberta and Great Waterways railway from Carbondale junction to 18th base line; a line from Dunvegan to Grande Prairie and northwesterly through Pouce Coupé to 21st base line; a line from Big River northerly to Ile à la Crosse, and a line along 19th base across ranges 5 to 9 west of the Sixth meridian.

APPENDIX No. 2.

SCHEDULE showing for each surveyor employed the number of miles surveyed of section lines, township outlines, traverses of lakes and rivers, and resurvey; also the cost of the same. Surveyors whose work cannot be reckoned in miles are omitted from the statement.

	Miles of section.	Miles of outline.	Miles of traverse.	Miles of re-survey.	Total mileage.	Total cost.	Cost per mile.
						$	$ cts.
Akins, J. R		216			216	25,293	117 10
**Aylsworth, C. F			37	79	116	5,134	44 26
Baker, J. C	307	86	111		504	18,396	36 50
Bennett, G. A			810	8	818	6,148	7 51
Blanchet, G. A		157			157	21,783	138 74
Boulton, W. J			897	38	935	6,496	6 94
Bowman, E. P			841	47	888	5,965	6 72
Brenot, L	300	60	68		428	19,265	45 01
Buchanan, J. A	364	108	127		599	17,413	29 07
Calder, J. A	96		3	14	113	9,749	86 27
Christie, W	278	91	84	12	465	15,793	33 96
Cote, J. M				473	473	15,645	33 08
Cowper, G. C			427	16	443	5,843	13 19
Davies, T. A			678	10	688	5,582	8 11
Deans, W. J	91	43	159		293	9,549	32 59
Evans, S. L			39	523	562	16,451	29 27
Fawcett, S. D	345	90	61	1	497	18,875	37 98
Fletcher, J. A		195			195	21,430	109 90
Galletly, J. S	52	19	131		202	10,152	50 56
Glover, A. E	325	121	1		447	17,908	40 06
Jackson, J. E	188	41	207		436	12,902	29 59
Johnston, J. H	378	132	28		538	18,413	34 22
Johnston, W. J	82		27	15	124	9,976	80 45
***King, J. A. S	73		34	294	401	9,866	24 60
Knight, R. H	338	63	131		532	18,224	34 26
LeBlanc, P. M. H	129	76	138		343	11,667	34 01
Lighthall, A	455	81	21		557	17,838	32 02
McEwen, D. F	392	64	48		504	17,745	35 21
McGarry, P. J	256	45	157		458	17,827	38 92
McKay, R. B	64		62	21	147	12,028	81 82
McKnight, R. H			818	7	825	5,667	6 87
Norrish, W. H	265	56	115		436	18,229	41 81
Palmer, P. E			596	94	690	6,011	8 71
Pierce, J. W	331	126	151		608	15,690	25 81
Rinfret, C			515	59	574	6,293	10 96
Scott, W. A			649	20	669	5,716	8 54
Seibert, F. V	434	82	146	24	686	18,271	26 63
Soars, H. M. R			751	6	757	5,736	7 58
Stewart, N. C	69		8	46	123	10,470	85 12
Stuart, A. G				513	513	8,443	16 46
Taggart, C. H	133		12	13	158	9,430	59 68
Walker, C. M			618	22	640	5,712	8 93
	5,745	1,952	9,706	2,355	19,758	535,024	27 08

*Total cost includes depreciation of outfit.
**Ceased work in July owing to illness.
***Took charge of Mr. Aylsworth's party.

APPENDIX No. 3.

DETAILS OF OFFICE WORK.

Letters and memoranda	7,540
Sketches, maps, and tracings	1,937
Descriptions of irregular parcels of land	23
Returns of survey examined:—	
Township subdivision	199
Township outline	155
Stadia plots	1,454
Townships investigated for water areas	639
Road and railway plans	651
Yukon lots and miscellaneous surveys	16
Mineral claims	21
Timber berths	4
Correction and other miscellaneous surveys	156
Preliminary township plans	278
Township and miscellaneous plans compiled	795
" " " issued	1,162
Sectional maps issued (3 miles to 1 inch)—	
New maps	4
Revised maps	20
Photographic work—	
Dry plates and films	649
Prints	6,058
Lantern slides	14
Wet plate negatives	2,187
Photo litho plates	560
Lithographic work—	
Number of maps	306
Copies of maps	124,767
Number of townships	1,095
Copies of townships	174,950
Number of forms	67
Copies of forms	66,073

APPENDIX No. 4.

INSPECTION OF SURVEYS AND SURVEY PARTIES.

Inspection by G. J. Lonergan, D.L.S.

The work which Mr. Lonergan had charge of consisted of the general business of the Government relating to surveys, and the inspection of survey parties. This inspection included reports on the instruments in use, the efficiency and organization of the party, the methods of performing the surveys, and the suitability and proper care of the transport. The general business included, among other things, the work of disposing of articles of transport that were of no further use. These were sold at public auction wherever possible, but in some cases where the articles were old and of little value, and had been stored at isolated places, private sales were arranged.

Contracts were also drawn up for the wintering of government horses and the storing of the outfits. Three places were accordingly arranged, one at Peace River, one at Prince Albert, and one at Portage la Prairie.

There were numerous other small jobs, such as shipping horses and various articles of outfit from one place to another for surveyors who required them, keeping in constant communication with surveyors in the field in order to attend to as much of their outside business as possible, such as engaging men to replace men who had left, looking after the shipping of supplies, etc.

During the inspection of a party in the field, all the instruments were carefully examined and the chains tested; notes were taken on the methods of running the lines and taking the astronomical and magnetic observations, and some of the block closings and observations were checked; some time was spent discussing the surveyor's methods and comparing them with those of other surveyors.

Seven stadia parties were inspected during the season. These were scattered throughout different parts of southern Alberta and Saskatchewan investigating dried-up or flooded water areas. Their work is important, and is caused by the changed climatic conditions resulting from agricultural development, drainage, and irrigation work. The shore lines of lakes are changed, some lakes drying up in whole or in part.

One party retracing old base lines and meridians was inspected, and also three parties in the Peace River district who were doing subdivision work in the bush country.

An accurate system of levelling is carried over each township, which will in the future be a great advantage in drainage work, the laying-out and locating of settlement roads, and the location of railways.

Four of the parties inspected were surveying in the railway belt, British Columbia. As most of the low land in the valley is now subdivided, the work is high up in the hills and, consequently, more expensive.

The conditions under which the different surveyors were working, as compared one with another, differed so greatly that the cost per mile was absolutely no guide in comparing the efficiency of the different men.

One party was subdividing in the valley of Chilliwack river where the fir trees are four feet in diameter, in a regular jungle of underbrush, while another surveyor was northeast of Revelstoke running part of the belt limit over snow-capped mountains. Blocks where one corner would be up on a mountain side fifteen hundred feet higher than the other corners closed as accurately as those of surveyors working in flat country.

Weather conditions varied in the different parts. In southern Alberta and Saskatchewan the spring was wet and, therefore, much time was lost, while in northern Alberta there was an extremely dry spring and summer. The first rain fell on July 3, and very little fell during the remainder of the season. The amount of rainfall made itself felt on the crops, as in the south an abundant crop was harvested, while in the north only the farmers who had their grain sown early, and who made some attempt to conserve the moisture, reaped any harvest. Hay was also scarce in the Peace River district, but this is the first time since the country was opened up that crops were a failure. Many intending settlers fear going into the Peace River valley on account of it being so far north, but the spring season is at least ten days ahead of Edmonton and the Edmonton district has proven itself beyond all doubt a successful farming country.

Inspection by A. M. Narraway, D.L.S.

The work on which Mr. Narraway was employed was of the same nature as that performed by Mr. Lonergan. Mr. Narraway visited eighteen parties, including those engaged on base line surveys and most of the regular subdivision parties.

To investigate all details, such as the suitability of the men for the particular class of work they were engaged in, the board and accommodation supplied to them, the suitability of the transport outfit and the care taken of the same, the manner in which the field work was performed, and a close examination of all field-notes, it was necessary for Mr. Narraway to remain in a camp two or three days, the first portion of the time being spent in actual examination, and the remaining portion in discussing the work with the surveyor in charge in order to come into close contact with every phase of it. Methods used by other surveyors in attacking problems of a similar nature were discussed, and an opportunity given to the surveyor to try these out in actual practice.

During recent years many changes have been made in the character of the surveying being done, necessitating new styles of equipment which must be supplied by the department or by the surveyor. In some cases the equipment must be devised and constructed by the department, with little practical information to build upon; in other cases the surveyor purchases the equipment at short notice in his immediate locality, where his choice is very limited, and the results are not always entirely satisfactory. Among the former might be mentioned the tools necessary for boring and digging the holes for planting the new style of iron post. Owing to the varying soils encountered it is extremely difficult to devise standard tools, and in districts where rock is found, special posts must be devised and equipment must be furnished for drilling the holes. This equipment must be light and compact and easily transported. Among the latter cases might be mentioned motor engines, democrats, wagon springs, etc., which are not stocked, and which take considerable time to obtain.

Eight of the parties visited were employed in township subdivision. Three of these were working in Manitoba, two in Saskatchewan, and three in northern Alberta. One of the parties in Manitoba was working along the east shore of lake Winnipeg, and the other two in Pas district. The country immediately east of lake Winnipeg is very low and wet, with scattered outcropping of granite rock. Passing from the large rock areas in northern Ontario westerly into Manitoba it is noticed that the rock outcroppings decrease in elevation, and that there is more level country until lake Winnipeg is reached, where the level country is the prevailing characteristic and the outcroppings more scattered. The east shore of the lake, therefore, is low, with numerous sand beaches, and broken here and there by the projecting rock which forms numerous bays with rocky points extending far out into the lake, forming dangerous reefs. In some cases, however, the muskeg reaches the water, and then usually moss in layers six and seven feet thick are exposed.

The country around Pas is low and flat, and is flooded frequently by Saskatchewan river. It is a country of lakes. About four miles above Pas, Carrot river enters the

Saskatchewan. Along this river there is some very good land, and with drainage systems properly installed, or with the prevention of the floods, this land will become valuable.

The two subdivision parties visited in Saskatchewan were working in the Prince Albert district, one near Candle lake and the other near the town of Big River.

The country around Candle lake is gently rolling and covered with bush. Settlement is gradually approaching the lake, with good roads to Prince Albert. Near the outskirts of the settlement very good progress is being made in farming. The soil is good and the clearing fairly easy.

The town of Big River is essentially a lumbering town, and is connected with Prince Albert by a branch line of the Canadian Northern railway. The mill located there, which is the life of the town, was running night and day, employing many hands and paying high wages. To the north of the town there is some good land available for farming, and there are some large hay lands on which considerable quantities of hay are being put up yearly by this lumber company.

In northern Alberta three subdivision and two base line parties were inspected. The first party visited was working about forty miles northeast of the town of Peace River, near Cadotte lake. The country there is gently rolling, and in many places thickly timbered. The other two subdivision parties were working farther north along Peace river.

The first base line party visited was working west of Fort Vermilion near the Sixth meridian along the 29th base line. The country around Fort Vermilion is gently rolling and lightly timbered, with considerable prairie lands, and is an excellent hay country. The banks of Peace river are not high, and goods from steamers are easily landed. Some very good farms are in operation at this northern town on both sides of the river, and good fields of wheat, oats, corn, and vegetables were seen. It is also worthy of mention that the crops were not frozen this season in the Fort Vermilion district, while they were in the upper Peace river country and the prairie districts so much farther south.

About fifty miles below Fort Vermilion the river widens to over a mile and the water rushes over a series of limestone ledges forming rapids and falls known as the "Chutes." Scows coming down the river are unloaded at the commencement of these rapids and run light past the "Chutes" and are then reloaded at the foot with the goods which have been portaged four and a half miles around along the bank of the river

About 100 miles below the "Chutes" small rapids are passed, extending along two miles of the river, but these are easily run by canoes or scows, and by larger craft in high water. These rapids and the "Chutes" above were the only rapids met with in the whole trip from Peace River to lake Athabaska.

Commencing at these rapids and continuing for about twenty miles below considerable outcroppings of gypsum are to be seen on both banks of the river. In places the whole bank is composed of this mineral and in one case an island of over five acres was seen with vertical banks of gypsum.

About twenty miles below these rapids at a long bend in the river a point is encountered, known as Peace point, so named by the Indians to commemorate the signing of a peace treaty between the Chipewyan Indians from lake Athabaska and the Beaver Indians from the Fort Vermilion district. Scattered across this point there are numerous holes from ten to twenty feet in diameter and about twenty-five feet deep, which were dug as fighting trenches in the fight just previous to the signing of the treaty. From this point and continuing northwards the country is rolling prairie with scattered poplar bluffs. The second base line party inspected was working along the 30th base line on the north side of Peace river. The banks of the river there were about 125 feet high.

From there the inspection party proceeded down Peace river to the south of the Quatre Fourches channel and up this stream to lake Athabaska and Fort Chipewyan. The Quatre Fourches channel, so named on account of the forks close to lake Athabaska serves as a drainage of the lake during low water in Peace river and during the high water of the Peace the water flows into the lake. During the fall of the year the current is very strong from the lake into the river.

Fort Chipewyan is built on a high rocky ledge on a point on the north side of lake Athabaska. It is a typical trading post. At present in addition to the Hudson's Bay Company's post there are several free traders.

The entrance from lake Athabaska into Athabaska river is exceedingly difficult to find, as there are several channels forming a huge delta, but in the fall of the year only two of these channels are serviceable. Extending out into the lake there is a mud ledge composed of silt carried down by the waters of the river; this ledge is about fifteen inches from the surface and the channel through it is hard to locate; even experienced travellers in this region are compelled to do considerable poling to follow it successfully. From Peace river to about twenty miles up the Athabaska only willow is to be found along the west and south sides of the lake, the banks of which are only a few feet above the water level. Behind the fringe of willow along the Quatre Fourches channel there are immense areas of hay lands ready to be utilized. The country just west of the lake is an ideal place for geese, waveys, and ducks, and immense numbers of them were seen. Whitefish and pink-eye were being put up by the Indians and the trappers for dog feed during the winter.

For about three miles below McMurray there is a very strong current which is caused by the widening of the river and the resulting shallowness of the water. In the fall only light boats are able to proceed to the town.

The next work was the reinspection of a survey contract of 1914 just below House River which required several days. At House River there is a telegraph station and a store. It has come into prominence because it is at the head of a long stretch of rapids on the Athabaska and is the starting point for a portage to McMurray. A pack train travels over this portage accommodating passengers and mail.

APPENDIX No. 5.

BASE LINE SURVEYS.

Survey of Base Lines by J. R. Akins, D.L.S., in Northern Alberta near the Sixth Meridian.

The route followed to reach the work from the town of Peace River was north along the sleigh trail to where it crosses Notikewin river. This point is about twelve miles from the northeast corner of township 92, range 22 on the 24th base line where the season's operations were begun.

Work was started on April 8 and by May 2 the 24th base line was completed to the Sixth meridian. The line was then continued twelve miles west of the meridian and on the 11th, the party started for the 25th base (north boundary of township 96). A few days previously two men had been sent ahead to find the end of the 25th base and blaze a trail which would be cut out by the party as the pack train moved up.

The route taken in travelling from the end of the work on the 24th base to the beginning of the work on the 25th base was: first back the trail along the 24th base to where it crosses the trail from Peace River to North Vermilion; along this trail north

to Hotchkiss river; and from there across country to the end of the 25th base. There was some difficulty experienced on this latter portion of the trail as it was necessary to cross about nine miles of heavy windfall.

The survey of the 25th base was begun on May 19 at the northeast corner of range 22; it was completed to the Sixth meridian on June 2 and was then produced eighteen miles west of the Sixth meridian.

On the 13th the trip of about one hundred miles was started to the 29th base (north boundary of township 112). This trip was by far the most trying part of the season's work. The days were long, there being only about two hours of darkness. The horses failed very rapidly, as the "bulldogs" or horse flies were especially bad last season, and the Indians say that they killed all the young moose.

The trail followed in going from the 25th to the 29th base was up the Sixth meridian trail to section 25, township 99; from there along the Peace River-North Vermilion trail to Keg River post; from Keg River post along a wagon trail to Chinchaga river; and from there along the Sixth meridian trail to the 29th base. Much of this latter portion of the trail was obliterated or filled with slash. The party reached the 29th base on June 25, and the survey was commenced at the Sixth meridian, running westward. For a while the work did not proceed very rapidly, as the weather was hot (the thermometer standing as high as 114 degrees Fahrenheit), the flies exasperating, and the water bad. The country was also thickly wooded, the line passing through some fine timber along Chinchaga river, but on July 18 the open country of Hay lake was reached. The breeze from the open country kept the flies in the woods, the water was good, and about three hundred fish were caught in a small stream on which the camp was pitched.

On July 22 the 29th base had been produced as far as Hay lake, in range 7. Work on this base was discontinued at this point and the party started for the 28th base (north boundary of township 108). This base had already been run westward as far as range 19, west of the Fifth meridian and work was begun in this range on August 3.

The trip from the end of the work on the 29th base to the beginning of the work on the 28th was about one hundred miles by trail and the route followed was as follows: back along the base line trail to the wagon road from Hay River post; thence along the wagon road in a southeasterly direction to range 18; and then on a trail which the party cut to the 28th base line.

This line was completed to the Sixth meridian on September 2 and was then produced twelve miles west of the meridian. When this was done the party moved south to the 27th base line (north of township 104) which had been previously run to the Sixth meridian. It was now produced eighteen miles west and the party then moved southeast to tp. 100-20-5, to the end of the 26th base. This line was then produced westward twelve miles west of the Sixth meridian where work was stopped for the season. On October 31 the party started for home. The horses were packed as far as the prairie on Notikewin river, where sleighs were hired with which to complete the journey to Peace river. This place was reached on November 10.

Along the 25th base through ranges 22 and 23 on both sides of the line the country is fairly open or lightly wooded with small poplar and willow. In range 23 the country is nearly all open and is well suited for immediate settlement; several settlers located there during the summer of 1916. Range 24 between Notikewin and Hotchkiss rivers is heavily wooded with spruce and poplar up to twenty-four inches in diameter. This timber extends four or five miles north of the line and ten or twelve miles south of the base line.

Hotchkiss river enters the Notikewin about twenty-five chains north of where the latter stream is crossed by the base line. The Notikewin thence flows in a northeasterly direction for some distance where it is joined by Meikle river which enters it from the

west. Along these rivers the soil is good and there are many fine flats. About twelve miles north of Meikle river is the southern end of the Hawk hills. These are a continuation of the Naylor hills, as there is only a slight depression of the elevation between them. The eastern edge of these hills extends north in range 22 to within four miles of the 26th base, where they swing westward running a little north of west. They cross the 26th base line in range 24 and the Sixth meridian in township 101. The southern edge follows Meikle river in a northwesterly direction and about six or eight miles from it crossing the Sixth meridian in township 98. There is a strip of fairly good timber on the southern and eastern slope. The top of the hills is lightly wooded with small spruce, poplar, willow, and alder. There is little feed but the soil is fairly good.

The country west of the Sixth meridian as far north as Chinchaga river is hilly and lightly wooded. The soil is fair and along the rivers there are some fine flats with good feed.

North of the 26th base line to about the 26th correction line there is a good strip of fairly open country that extends from near the Sixth meridian to Peace river. The good country also extends a few miles south of the 26th base line. Part of this strip is what is known as Keg River prairie, which though not very large, as it comprises only about two townships, is as fine a piece of country as could be desired.

A strip of open country joins Keg River prairie with what is locally known as Paddle River prairie. This is a strip of open country about a mile wide lying along the south branch of Paddle river or as it is called on the explorer's map, Oliver river. A wagon road runs from Keg River post following this open country to Fort Vermilion. One thousand pounds can be taken over this road by a team of cayuses in a wagon.

North of the 26th correction line to the 28th correction line and from Peace river to the Sixth meridian is a fine stretch of level country with good soil. The only drawback to this section of country is that the water is very disagreeable having alkaline and iron salts in solution, though it appears to be all right for stock. This is probably due to the presence of sodium chloride which is a necessary ingredient of their food. The portion of this country lying south of the 27th base is covered with considerable windfall, but north of that there is very little, the surface being lightly wooded with poplar, willow, and some spruce. There are also many open patches.

West of the Sixth meridian to within a mile of Chinchaga river and north about three townships from the 27th correction line lies a section of poor country, being made up of bogs and muskegs. This area would be of no use in its present condition, but might be valuable when drained.

Between the 28th correction line and the 29th base line lies the Watt mountain. Its direction is about west-southwest, its northeast end being about three miles south of the 29th base line at the east side of range 21, and its southwest end about the correction line in range 23. It is lightly wooded and the soil is inclined to be stony.

From Watt mountain north to Hay river and westward to Hay lake is a country very similar to that previously described lying south of the 28th correction line. The land is very level and the water unpleasant. The soil is good and generally lightly wooded or open. There are, however, some fine patches of timber on points along Chinchaga river that have escaped the fires. In these patches are some very fine spruce, tall, straight, and with a diameter up to thirty inches.

Around Hay lake the country is very level. At one time there was a large body of shallow water probably twenty miles in length by eight or ten miles in width. The greater part of this is now dried up, and on the old smooth, level lake bottom is an abundant growth of fine hay, and many thousand tons of hay could be cut without any improvement, and with some draining this amount could be doubled. There is, however, a possibility of it flooding, due to a heavy fall of snow during the winter and a quick thaw in the spring. The Indians say that there has been no flood for the past fifteen years, but they are always afraid to leave their horses all winter in the vicinity of the lake in case they get caught in a spring flood.

South of the lake is a ridge of high hills about thirty miles long in a direction nearly east and west, on which ranchers or settlers should erect their buildings. South-east of this ridge a fine growth of spruce timber is reported. A railroad built from there to Peace River or to a railroad joining the town of Peace River with North Vermilion (the preliminary survey of which was to be made last winter) could be used to ship out the timber or hay to other parts of the Peace River district wherever needed. Such a road could be cheaply built, as the country through which it would pass is very level, with no hills, valleys, or muskegs. No rock in place was seen during the season, nor any mineral.

Moose are fairly plentiful, especially in the vicinity of Notikewin river and its tributaries. Feathered game is scarce, except geese in the spring and ducks in the fall, but of these there are many. Animals such as lynx, black, silver, and cross foxes, mink, fisher, bears, marten, and ermine are plentiful, and many settlers and others find very profitable occupation during the winter months trapping these animals.

Fish, especially jackfish, are very plentiful in the Hay Lake district. There are also some fish in Chinchaga river, but as the water of this river is not very favourable to them, they are not very numerous. Chinchaga river has its source in the muskegs on the Clear hills and on the divide between it and Liard river. The water is therefore a brown colour like all muskeg water. Neither this river nor Hay river is navigable, except for canoes or gasolene launches, and Chinchaga river is also well suited for similar craft, except for a series of small rapids at its farthest west point directly west of the west end of Watt mountain.

Survey of Base Lines by G. H. Blanchet, D.L.S., in Northern Saskatchewan.

An early start was made by Mr. Blanchet for the survey of portions of the 19th and 20th base lines west of the Third meridian. The party left Prince Albert on March 15 and Big River, the end of steel, the following day.

A good winter road runs from Big River to Ile a la Crosse, by which fish are brought out from the northern lakes and trade goods and supplies brought in for distribution by water during the summer. This route is good for travel till about the end of March, though by that time the portages between the lakes are beginning to get bare. Usually baled hay is obtainable only at La Plonge, and there are no oats to be had after leaving Big River.

Ile a la Crosse, which is about 175 miles from Big River, was reached on March 22, but the freighters who were bringing in the supplies did not arrive till the 25th and consequently the party were delayed as the freighters had most of the horse feed. From Ile a la Crosse there was no trail broken, and as the snow still lay deep and heavy in the bush, it was necessary to send a party of men ahead on snowshoes followed by a four-horse team hauling an empty sleigh to make a trail passable for loads.

Camp was pitched near the end of the line, in range 17, on March 28 and the starting point was checked the same day. On the following day the work of producing the line began. Sleighs were used for transport as long as the snow and baled hay lasted. The cache there included hay for a month and oats and supplies for two months. This was the maximum that such a transport outfit could handle, and later it was necessary to assist the horses by doing a certain amount of man-packing. On April 21 the last of the hay was used, and as the ground was bare in open places the sleighs and harness were cached and horses used for packing. On move days the men assisted by packing their beds and dunnage to the end of the line. The spring was a very disagreeable one with falls of snow at intervals till the first of June. This made the spring growth very backward and as a result of the poor feed combined with the heavy work several of the winter horses were completely played out.

The 19th base line was completed to the Fourth meridian on May 26, and the next day a start was made north for the 20th base line, which was reached after three days'

travel. The grass had now grown sufficiently in the more open places to supply fair nourishment to the horses and during the remainder of the season feed was plentiful.

Fortunately the amount of chopping on the line was not great, and, in spite of the shortage of men, some of whom had quit, the work progressed well, while the light loads gave the horses a chance to recuperate. Men and supplies reached camp on June 19, and during the next month under favourable conditions of weather and country the line was produced without difficulty through the hilly district of upper Dillon river. From range 19 to range 12 good waterways exist and all the heavier transport was handled by scow towed by a canoe equipped with a gasolene engine. The country eastward from range 19 is comparatively level and on account of the poor drainage there is much lake and swamp land.

Eight crossings of Ile a la Crosse lake and its bays were made, and for transporting the men and supplies the gasolene boat was invaluable. The horses were found to be almost useless there, so were sent back to Edmonton.

After leaving Ile a la Crosse lake all supplies had to be handled by man-packing. No horse feed was seen in the country passed through east of the lake and trail work for horses would be very heavy. The work there after several moves proved too much for the local Indians who were hired to replace some men that had quit, and most of them left. It was, therefore, decided to close work for the season after running to the easterly side of range 10. The outfit and party, now reduced to thirteen, were taken out by means of the gasolene boat and scow, up Beaver river to Green lake, and thence overland by Meadow lake to the railway at Meota and by train to Battleford, where the party was disbanded.

The precipitation during the season was heavier than normal and consequently the lakes and rivers were unusually high. The spring was decidedly cold and the summer mostly cool with much high wind. Mosquitoes were exceptionally numerous which was one of the factors making it difficult to keep men in the bush.

Description of the Country.

From range 18 westward the country rises fairly steadily on both base lines to the height of land near the Fourth meridian, the rise amounting to about seven hundred feet. The direction of drainage is roughly northeast, and the surface of the slope varies from gently rolling to hilly. The distant sky line, where seen, usually appears as a long ridge. Eastward from range 18 the surface is, in general, fairly level.

The district traversed during the season forms part of the drainage area of Churchill river. Three principal streams drain this district, flowing towards Churchill river, namely, Beaver, McCusker, and Dillon rivers. Beaver river, of which Calder river is a branch, after flowing in a great circle to the south, swings back to the north and enters Ile a la Crosse lake at its southeasterly corner. McCusker river rises in the hills to the west of Canoe lake and flows northerly into Niska lake and thence by Little Buffalo lake and McBeth channel to Ile a la Crosse lake. Dillon river and its tributary streams form the most important topographical feature of the district considered. It absorbs nearly all the water draining from the hills to the west and southwest of Buffalo lake. Along the course of these streams and the numerous lakes they drain is to be found the best land of the district. Dillon river drains through Buffalo lake and McBeth channel to Ile a la Crosse lake. Churchill river flows out of the northeasterly corner of this lake.

Water-power could be developed on all these rivers as rapids are numerous and the fall in them sometimes considerable, but only in Beaver and Churchill rivers is the discharge sufficient for any large development of power.

The soil of this district varies from an almost pure sand to heavy clay and nearly everywhere contains some gravel or boulders. The accumulation of mould is nowhere deep owing to forest fires. In general the soil is better on the lower slopes of the elevated region and especially along Dillon river and its branches.

In the level country to the eastward the soil seems to be chiefly glacial débris, in which boulders are thickly strewn. The shores of the lakes and beds of streams are usually formed entirely of boulders. There are no outcrops of rock in this district though it was reported that tar sands had been observed on Buffalo lake.

In common with most of the northern country the original timber has been burnt off almost everywhere though a former splendid forest growth is evidenced by scattered clumps, isolated trees, and burnt stumps and logs. Brule six months to thirty years old was observed, showing that many different fires had swept the district. In the hilly country along the 19th base line in ranges 18 to 23 there is a sturdy second growth of poplar, spruce and birch which should make good material for a forest reserve.

Most game and fur-bearing animals common to the North are to be found there, and hunting and trapping are the chief occupations. Good fish are found in most of the lakes, and in the larger lakes during winter, whitefish are caught and exported in great numbers.

With the opening up of the country ranchers may be attracted by the good growth of hay in several localities. The Alberta and Great Waterways railway which passes about forty miles west of the Fourth meridian brings this district within reasonable touch of civilization.

Survey of Base Lines by J. A. Fletcher, D.L.S., west of Lake Athabaska in Northern Alberta.

To reach the scene of Mr. Fletcher's survey operations, the party travelled down Peace river to Chipewyan, at the head of lake Athabaska. Three scows were required to carry the party, camp outfit, supplies, iron posts, oats for the season, twenty-five horses, and the necessary feed for the trip down the river. At Fort Vermilion three more horses were loaded on the scows as well as two wagons and two sets of harness to be used on the portage at the "Chutes," which were reached on May 8.

A wagon portage has been cut on the south side of the river around the Chutes, by the Hudson's Bay company. The road commences about a mile above the rapids where there is a good steamboat landing and after four and a half miles reaches the river again about a mile, below the Chutes where there is another good steamboat landing. The scows were unloaded at Big island in tp. 112-23-4, after which camp was moved to the vicinity of the 29th base in range 24.

On May 16 the survey of the 29th base line was commenced and the work was continued without interruption until the survey was closed in range 17 on the 30th base line on October 7, about two hundred miles having been surveyed during this period.

On June 1 as the line was nearing Peace river in range 21, three men were sent to bring to camp the scows and supplies from the vicinity of Big island. These scows were used to cross the horses over Peace river and also for moving camp from range 21 to range 19. In range 20 the surplus supplies and oats were sorted into one scow and sent to Chipewyan where they were stored. Three canoes were used on Peace river. One of these was sent to Chipewyan with the scow, while the other two, together with about two weeks' supplies, were cached in range 19. The other two scows were sold to the Hudson's Bay company.

On reaching lake Claire, section lines were run around the north end of the lake in ranges 14 and 13.

On the arrival of the party at lake Athabaska, it seemed that the pack train would not be needed for fifteen or eighteen days, so it was left in charge of the third packer, while the first and second packers took six horses and, with some assistance, put up sufficient hay to winter the packhorses, seventy-five or eighty tons being stacked on the west side of the Quatre Fourches channel in township 111.

Work for the season was stopped in township 117, range 16, and the trip out begun on October 8.

From range 24 to range 15, the land along the base line is of the same general nature. The surface is rolling as far as the end of range 19, at which point it rises abruptly, gradually sloping again to lake Claire in range 14. The soil is alluvial westerly from range 20, and swampy areas are found throughout except in range 19. Timber grows to merchantable size except in the swampy parts and on the ridges, the principal species being spruce, birch, tamarack, poplar, and willow, with jack pine in patches. In ranges 17 to 15 the soil is lighter and the timber consequently smaller.

The country from ranges 14 to 8 inclusive is almost level, all this land being only a few feet above the level of lake Athabaska and lake Claire, the soil being mostly formed by alluvial deposits from Peace and Athabaska rivers. Most of the country from the north end of lake Claire for a distance of two miles and to the east of lake Claire to lake Athabaska is alternate hay meadow and willow fringes, with patches of timber and brulé and some good milling spruce along the three channels from Peace river, the most important of which is the Quatre Fourches channel. This district would make an excellent stock country as hay grows in abundance; it is, however, subject to flood in abnormally high water. There are numerous sloughs and lakes in this area and vast numbers of ducks and geese stop here before their flight south in the fall. These form the staple meat diet of the people of Chipewyan most of the year. The western end of lake Athabaska is very shallow and the channel of Rocher river can be easily traced out past Chipewyan into the main body of the lake.

In the spring lake Claire and Mamawi lakes are drained by the Quatre Fourches channel into Peace river. In June and July the water in Peace river is high and Quatre Fourches channel reverses and flows into lake Athabaska. The middle channel flows through Baril lake into Mamawi lake and thence into both lake Claire and lake Athabaska. Claire river also flows into lake Claire. Should the Peace be more than usually high the water also flows by Rocher river into lake Athabaska. In July the waters of Peace river subside and about the first of August the Quatre Fourches channel begins again to flow toward the Peace, while Claire river and Baril river become back-waters blocking near Peace river. As the Peace continues to fall in September and October, Quatre Fourches channel attains a current of three to four miles an hour but navigation remains unobstructed. Rocher river, however, develops considerable rapids on either side of the island crossed by the east outline of range 8 in township 114. Only boats with surplus power can ascend these rapids in low water; other boats avoid them by going up the Quatre Fourches channel.

Mamawi lake is shallow with weeds growing to the surface in most parts. Its shores are generally marshy for some distance before solid ground is reached. Baril lake is also shallow but the weeds are not so prevalent as in Mamawi lake. No place was found in either of these lakes, except near the intakes or exits, where the water exceeded five feet in depth. Lake Claire is a large body of water with numerous bays and peninsulas. The channels joining it to some of the small lakes near it, or to some of its bays, are quite deep, the action of the wind sometimes causing strong currents in them. The shores of lake Claire are generally solid and of a peaty composition, and hay grows abundantly all around it. Numerous old back-waters, sometimes four or five miles long, wind about the country and sloughs with marshy edges are quite frequent. Sedimentary action is constantly going on in lake Claire, Baril lake, Mamawi lake, and the western end of lake Athabaska.

East of Rocher river the county is mostly of the Laurentian formation, the surface being rolling and broken with rocky ridges and valleys between, with the soil light and swampy. The timber on the hills is mostly jack pine, while in the valleys the timber is spruce, poplar, birch, tamarack, alder, and willow. There are numerous small lakes and ponds in this country, the nature of which remains much the same

up to the 30th base, and continuing rocky and broken, some of the hills being 160 feet high.

On approaching Slave river on the 30th base line from the east, alluvial soil is reached in the second mile from the river. This alluvial soil extends through range 9 and the eastern half of range 10. This country is almost level, has a rich black loam, and is covered with spruce, poplar, and some tamrack, with willow and hay meadows. Ranges 9 and 10 are drained directly by Slave river and Murdock creek, which is about forty feet wide and has a sluggish current and banks about fifteen feet high. Peace river in high water floods into this creek, when there is a good current, but usually the Peace does not flow into this stream, and the water stands almost at a level with its mouth where it joins Slave river, near the 31st base line.

The western half of range 10 changes to lighter soil, and range 11 consists of sandy ridges and rolling country, with flat intervals of marshy meadows and tamarack swamps. There is considerable old brule in this area, with scattered patches of green spruce, poplar, tamarack, and jack pine.

On entering range 12 the country is still rolling and the soil fairly good, though somewhat light. Jack pine to twelve inches, some spruce, and poplar form the timber. Some stretches of good milling spruce up to eighteen inches in diameter border Peace river. North of Peace river about five miles a swampy area, with some lakes and sloughs is entered, and the drainage is in somewhat sluggish streams toward the northeast. In range 13 some moss-covered ground with spruce timber and some spruce muskeg was passed over, entering better country to the west. Ranges 14 and 15 contain some good agricultural land, the soil being a clay loam, timbered with small poplar, with a good growth of grass and peavine. Underlying this ground at varying depths are areas of gypsum.

Ranges 16 and 17 are alternate loam and sandy loam areas with some light rolling ridges south of Peace river.

The only place where farming operations have been attempted in this district is at Chipewyan. The settlement there is located on a rocky point extending southward into lake Athabaska. There are some small patches of good clay loam soil between the granite hills, and in these vegetables such as potatoes, turnips, lettuce, beets, etc., are grown successfully.

Power could not be developed economically anywhere in this neighbourhood. No coal seams were noticed and no stones or minerals other than gypsum and granite were in evidence. The climate was very fine, the month of June being rather dry, but rain fell frequently and not excessively in July, August, and September, so that vegetables grow very well at Chipewyan, while wheat, oats, potatoes, etc., were a fine crop at Fort Vermilion. This is noteworthy when it is known that the frost spoiled the crops at Peace River and many sections of the West during 1916.

Jackfish, ling, pickerel, gold-eye, and whitefish seem plentiful in the rivers, lakes, and back-waters in this country. Partridges and chickens are quite often seen, especially near Peace river. Fur-bearing animals are plentiful, foxes, mink, beaver, lynx, muskrats, skunks, etc., being seen. At present the fur trade is the chief source of income to the people in this country. Their living is helped by the ducks, geese, fish, vegetables, and game found or grown there. Very few moose were seen during the summer, but bears are fairly numerous along Peace river, while some buffalo tracks were seen north of Peace river from Point Providence.

There is enough timber in the country to meet the building requirements of settlers for some time. The Roman Catholic mission have built a saw-mill near Chipewyan to supply local needs. Minerals have not been found of economic value, but some prospectors are making some tests by drill on the east end of lake Athabaska, nickel, copper, and silver being supposed to be present in paying quantities.

APPENDIX No. 6.

SUBDIVISION SURVEYS.

Surveys by J. C. Baker, D.L.S., North of the Town of Peace River, Alberta.

The townships in which Mr. Baker was employed lie along the Sixth meridian, north of Whitemud river.

The work was reached from Peace River by the Bear lake and Battle river wagon trails, the latter crossing the 24th base line in tp. 92-22-5. The trail as far as Bear lake was good, but from there to the 24th base line it was very bad in places.

The streams in this work were not traversed at the time of survey on account of the heavy growth of willow and the high water. The work was done later in the season when the traverse could be made on the ice.

The surface of township 89-25-5 is nearly half muskeg and is not therefore suitable for settlement. The westerly half of tp. 93-24-5 is heavily timbered, and was consequently not subdivided. The whole of tps. 92 and 93-23-5 was subdivided as well as tp. 92-22-5. When the subdivision was completed the assistants and most of the party were paid off, only enough men being retained to do the traversing.

All the land subdivided is at present covered with small poplar and willow, which can be easily cleared, and the area is well watered making it suitable for either ranching or mixed farming.

Surveys by L. Brenot, D.L.S., in Peace River Block.

The area covered by Mr. Brenot's surveys consists of land on both the north and south sides of Peace river, between ranges 15 and 18 west of the Sixth meridian. This country is easy of access and the clearing and cultivating of the land would not be difficult. The plateaux lying on top of the Peace and Pine river hills is undulating, sometimes timbered, but more often covered with a growth of small poplar. The slopes of the Pine and also those of streams flowing into the Peace, are generally grassy and afford good grazing, with the additional advantage of being cleared of snow in the spring long before the bottom land or plateaux. The soil is fertile with a luxuriant growth of grasses. Clearing in many places would not be difficult and much of this land will probably be homesteaded in the near future. The country as it stands, with its numerous hay sloughs and creeks, several of which have a permanent supply of fresh water, forms a most desirable range for stock.

From Spirit River the party travelled north to Dunvegan and thence on the ice of Peace river to tp. 82-17-6 where work was begun. After completing the subdivision of this township and tp. 81-17-6 and also the survey of the east outlines of tps. 81 and 82-16-6, the outfit was moved to the north side of the river. Considerable difficulty was experienced in crossing the river as it was in flood, and though the party crossed safely, one of the horses was drowned.

The subdivision of tp. 84-16-6 was begun on May 26, after which the survey of tp. 83-16-6, tp. 84-15-6, and the north third of tp. 82-16-6 was proceeded with. On September 29 this work being completed, survey operations were closed for the season.

The homesteading and farming prospects throughout the various parts surveyed are for the most part, very encouraging. In the southern portion of township 82 and the northern third of township 81 range 17, the soil is fertile, being sandy clay with clay subsoil, the rich growth of grasses and peavine showing great possibilities for

mixed farming. The necessary clearing in townships 82, 83 and 84 range 16, is comparatively little, the land is rich and fertile as proved by the luxuriant growth of grasses and peavine, and the soil is for the most part four inches of black loam with a subsoil of clay loam. North Pine river runs through township 83, providing a permanent supply of fresh water. Township 84, range 15, with the exception of the southeast quarter, is well timbered with poplar and scattered spruce and jack pine. The southeast portion is one of the richest and most fertile parts encountered in this district, loam to a depth of twelve inches, overlying a clay and sandy clay subsoil being a fair description of the soil. Moose creek running near the east boundary of the township provides a permanent supply of fresh water.

The climate can be compared favourably with that of southern Alberta, and is free from the extremes so often attributed to it. The summers are moderately hot, and generally have an adequate rainfall. Summer frosts were frequent during the season, and most crops were injured, but during previous seasons crops suffered little or no damage from summer frosts.

The condition of travel into this district has greatly improved during the last few years. Since the completion of the Edmonton Dunvegan and British Columbia railway from Edmonton to Peace River, Spirit River and Grand Prairie, only a short distance has to be travelled by teams overland and the trip can be made in six or seven days. In the summer prospective settlers can reach this country by travelling by rail to Peace River, thence up the river, by one of the several steam or gasoline boats which ply between Hudson Hope and Fort Vermilion during the summer months. The trip can also be made by railway as far as Spirit River or Grande Prairie and from there to Fort St. John, by a good wagon road, cut at the time of the construction of the Government telegraph line to Fort St. John and Hudson Hope. No ferries are as yet in operation on Kiskatinaw, Pine, and Peace rivers which this trail crosses. In winter this trail is the most practical route, and mail is carried over it into the Fort St. John district twice a month.

Surveys by J. A. Buchanan, D.L.S., in Peace River Valley.

The townships subdivided by Mr. Buchanan last season lie in the Peace River valley about fifty miles north of the town of Peace River.

The general plan carried out during the season was to camp on the river where it was possible to move often, in order to shorten the time of walking to and from work as much as possible. Of course a great many camps had to be made inland but as the river was used as a base of supplies throughout the whole season, the transportation was not a difficult proposition, as the horses were not obliged to move supplies any great distance and for the most part were required only to move each lot of supplies once instead of handling and reloading them, as is required under different transportation conditions. All the work was completed to the correction line moving north, then by sending out three fly camps, the east outlines of townships 96 and 95, range 20, township 96, range 19, and townships 95 and 96, range 21, were run south from the base line. In this way the main camp was kept near the base of supplies and moving down stream in short moves was easier than tracking up as the party would have been obliged to do, had they carried on subdivision work from the base line south to the correction line instead of from the correction line north to the base line.

The conditions under which the party worked were by no means ideal. The country was rough and in most parts densely wooded if not heavily timbered. The mosquitoes were particularly aggressive and unusually active through practically the whole season, which is an exception as generally there is a considerable time at both the beginning and the end of a season's work when the flies and mosquitoes are not troublesome.

On the morning of October 15 the party went aboard the "Northland Call" en-route for Peace River. The traverse party was let off in township 93, range 20, and started work on Peace river, drifting down stream as the main party had done, while the remainder of the party was paid off. After completing the traverse the party reached Edmonton on November 22.

Surveys by W. Christie, D.L.S., Northeast of Prince Albert.

The area surveyed by Mr. Christie lies in the immediate vicinity of Candle lake, about fifty miles northeast of Prince Albert and consists of tps. 55 and 57-22-2, tps. 55, 56 and 57-23-2 and the north third of townships 54 in ranges 22 and 23.

Two wagon roads from Prince Albert lead to this district. The more westerly one passes through settled country by way of Henribourg in tp. 51-25-2 and Paddockwood in tp. 52-25-2. From Paddockwood a road locally known as the "Mosher Trail" runs northerly across township 53, and thence northeasterly across townships 54, in ranges 24 and 23 to the bank of a creek about half a mile from where it empties into Torch lake. This road is graded and in fairly good condition as far as the north boundary of township 51. Through township 52 it is also fairly good, some improvements having been made on it by the Provincial Government during the past summer, but north of township 52 the road was very bad.

The more easterly of the two roads referred to is the old trail from Prince Albert to Candle lake. This road passes through townships 54 ranges 23 and 22 and township 55 range 23 between Torch and Candle lakes to the fishing station on the southwest shore of Candle lake in sec. 26 tp. 55-23-2. Parts of this road are impassable for wagons in its present condition.

The route followed was via Henribourg, Paddockwood, and the Mosher trail, to tp. 56-23-2 where the work was begun on June 7.

Candle lake is a beautiful body of water covering an area of a little more than fifty square miles, its greatest length from northwest to southeast being approximately twelve miles. Though it extends into five townships, namely, townships 55 and 56, ranges 22 and 23, and township 57, range 23, more than half its area is in township 56, range 23. With the exception of a small bay at the southeast end and a small strip in township 57, range 23, the shores are clean with either a sandy or stony beach. Whitefish are plentiful and a few years ago fishing in this lake was rather an important industry.

The Hudson's Bay company formerly operated a trading post at Candle lake, but it was abandoned a number of years ago. With the exception of a small garden there is now no indication of any land ever having been cultivated.

Torch lake lies to the south of Candle lake in township 54, range 23, and townships 55, ranges 22 and 23. It has an area of approximately four and a half square miles, its greatest length being about five miles. It is a very shallow, reedy lake, and is from three to six and a half feet deep. The east shore is mostly sandy and stony while the west shore is marshy.

In this whole area the surface is generally gently rolling and around Candle lake is heavily wooded. Except in the muskegs the soil is mostly clay loam with patches of sandy soil.

All the muskegs and swamps are shallow, and there is ample slope to the ground to render draining comparatively easy. If these muskegs were drained and the moss burned off, they would no doubt produce abundance of hay if they did not prove suitable for other crops.

Wood for fuel is plentiful throughout the area covered by the survey.

Practically the only hay land found is that to the north and west of Torch lake in township 55, range 23. Fairly good grass for grazing grows in the woods, however, especially where it has been overrun by fire.

Big game is plentiful, consisting of moose, elk, caribou, jumping deer, and bears. Coyotes are also very numerous, and foxes, lynx, beaver, muskrats, and ermine were also noted. A few partridges were seen.

No coal, lignite, stone-quarries nor minerals of economic value were noted.

The climate is similar to that at Prince Albert. Summer frosts occur, but severe frosts at the time when crops would be seriously damaged are the exception rather than the rule.

The prevailing weather conditions in this district throughout the greater part of the season were very unfavourable for survey work. The unusual amount of wet weather not only caused the actual loss of a good deal of time, but also rendered the condition of most of the roads and trails such that transportation was difficult and costly.

Surveys by W. J. Deans, D.L.S., in Northern Manitoba.

The first work on which Mr. Deans was engaged was the survey of lands at Norway House, which had been squatted on by Indians and other settlers. It was at first thought advisable to subdivide the lands into sections and give the settlers legal subdivisions embracing their improvements, but the settlers were so close together that it was necessary to lay out lots to deal with their claims satisfactorily. Lots were therefore laid out on each side of Nelson river in tp. 57-3-Pr. and 57-4-Pr.

The settlers are engaged in fishing, hunting, and working for the Hudson's Bay company. A few have good gardens and raise potatoes and vegetables which could not be excelled, but the demand is much greater than the supply.

By request of some of the settlers, a site for a public school was laid out, and in this township is also situated the Mounted Police barracks.

The next work was the subdivision of tp. 58-3-Pr. Little Playgreen lake occupies a large part of this township, and some difficulty was experienced carrying the meridians over it, long triangulations being necessary. A great many islands lie in this lake, many of which were traversed. The Methodist mission and Indian school are located in this township on the shores of the lake. A large number of Indian children attend the school, which has a very enthusiastic superintendent and an efficient staff of teachers. This school is accomplishing much good in educating the Indian children and teaching them to do useful work. It is well heated, lighted with electricity, and has all the modern conveniences to be found in any similar institution.

Norway House, a post of the Hudson's Bay company, is situated on the south-west quarter of section 3, in township 58. There was in former years a great deal of business transacted at this post, but of late many private traders have entered into competition with the company and taken away considerable of their trade. The building of the Hudson's Bay railway has cut the business off from the north entirely, so that now all that keeps the post going is the local trade and the supplying of a few outposts to the east. Many tourists visit the place during the season of navigation, the boats leaving Selkirk every Monday.

The next work was at Cross lake, which was reached by the usual route from Norway House, being over Little Playgreen lake and down Nelson river, a distance of about sixty miles. There are five portages on this route, and a number of rapids which, however, can be run without danger by experienced canoemen. The country along the Nelson between Norway House and Cross lake is high and dry along the shores with rock and small patches of good soil, all covered with a thick growth of small white poplar, tamarack, birch, and jack pine. A short distance in from the river are tamarack and spruce swamps. The appearance of the country from the river is very deceptive; the traveller might think he was passing through a fairly good agricultural district, but the dry land extends only a short distance back from the river. About ten miles south of Pipestone lake the rock formation changes from the Lauren-

tian to the Huronian. There is an extensive area occupied by these mineralized Huronian rocks, which offer great inducement to the prospector. This part is easily accessible in summer, as streams and lakes cut it up, and a prospector could get in with his supplies comparatively easy.

The party arrived at Cross lake on September 1 and the next day started to run the east boundary of tp. 65-3-Pr. The boundaries of the land applied for by the Roman Catholic mission were traversed, three lots claimed by squatters were surveyed, and a portion of tp. 65-2-Pr. was subdivided. The land is rocky along the shores of Cross lake, and swampy a short distance inland. There are some small patches of good soil which yield remarkable crops of potatoes and vegetables. One of the squatters had thirty-eight potatoes which weighed sixty-three pounds, and on one-tenth of an acre had eighty bushels. Cabbage, cauliflower, turnips, carrots, and vegetable marrow were raised at the Methodist mission and were of excellent size and quality. Summer frosts occasionally destroy the gardens, but not more frequently than farther south. There is considerable hay in the marshes along the lake but owing to high water last season the settlers were unable to cut it. Fish, of which there is an unlimited supply, is the principal food of the Indians. The township is covered with a thick growth of white poplar, jack pine, spruce, and hemlock, varying in size from three to twelve inches.

On completion of the work at Cross lake the party returned to Norway House on September 29 and completed the stadia traverse at that place on November 17.

The route out was north to the Hudson Bay railway by dog teams and then by rail to Winnipeg.

The next work was the subdivision of Elk island. This island is close to Victoria beach, a summer resort on lake Winnipeg, north of the city about seventy-five miles. The island is mostly high and dry with banks in places forty-five feet high. The beaches are very fine, being sand and gravel, and the water is quite shallow. The soil on the island is mostly sand and of no value for agricultural purposes. The surface of the island is covered with a thick growth of willow, poplar, jack pine, and spruce, varying in size from three to twelve inches, but there is very little of the latter size. The island will make an ideal summer resort.

On January 5 the party commenced a subdivision survey at Birch River station on the Canadian Northern railway in tp. 39-26-Pr. About two years ago there was a big saw-mill at this point and a large number of men were working in the mill who lived in houses erected by the mill owners on land adjoining the railway right of way. The mill was destroyed by fire and these houses are now rented by people having homesteads in the vicinity. Some of these people now wish to purchase these lots and in order to deal with this matter it was necessary to make the subdivision. This work was completed on January 22.

Surveys by S. D. Fawcett, D.L.S., in the Peace River Block.

From Spirit River the end of steel on the Edmonton Dunvegan and British Columbia railway, Mr. Fawcett used wagons for the remaining distance of 125 miles to the work.

For the first portion of this road to Pouce Coupe there is a pack-trail which in spring and early summer is passable for wagons, and from the latter place a wagon road is cut as far as South Pine river in range 21. The steep banks of Kiskatinaw river and the other streams crossed, however, render this route difficult to travel and as the Kiskatinaw cannot be forded during flood, which occurs about the first two weeks in July, this portion of road is impassable during that period.

The work consisted of the subdivision of townships 79 in ranges 17, 18 and 19, townships 77 and 78 in range 18, and portions of townships 80 in ranges 17 and 18. Work was commenced in tp. 77-18-5 on April 4, but, as some of the steep slopes were still covered with three feet of snow over bad windfall, progress was slow.

In this whole area the valley bottoms are wide and covered with alluvial soil which is very good for farming. Along Kiskatinaw river the land for half a mile back from the banks is rough and broken with ravines and coulees, caused by drainage into the river. The hilly portions farther back afford good grazing in patches, but ranchers claim that extensive ranching is not possible as there is not enough hay for winter feeding. The land is good for farming when cleared of poplar and willow.

A good belt of timber crosses townships 80 in ranges 18, 19 and 20, but most of the original forest growth in the remaining area has been burned off leaving only some rampikes to show what was once a splendid timbered area. No recent fires have overrun this district as it is now well patrolled by fire rangers.

During July, floods filled the streams, rendering them difficult to cross with a pack-train, but in autumn most of them dry up or become very small.

The climate is not subject to sudden changes, and although frost did damage to crops last year, the grain crop and vegetable yield were excellent the previous season. Damage from frost will likely disappear when the land is cultivated.

Moose, bears, jumping deer, and foxes are plentiful but partridges and chickens are scarce.

Surveys by J. S. Galletly, D.L.S., in Northern Manitoba.

Mr. Galletly began operations on April 1 on the east boundary of tp. 56-30-Pr. and on the north boundary of tp. 55-29-Pr.

After the completion of these lines the survey was continued of the settlement along Carrot river in ranges 28 and 29, which had been commenced during the season of 1915. This work kept the party engaged till May 23, when it became necessary to survey the east boundary of tps. 55 and 56-31-Pr. As this line crossed Birch, Elm, and Saskatchewan rivers and ran through much swampy land, it was necessary, in order to reach the starting point on the 15th base line, to go to Pas and around by Saskatchewan river. From this point the line was produced southward for nine miles. The party then attempted to complete the line from Carrot river by running north, but the flooded condition of the river rendered this a difficult task. The continued rainfall kept the water rising till not even a dry place could be found for a camp and the work was discontinued on June 19.

The party resumed work on November 15 and commenced the survey of a wagon road in tp. 55-27-Pr. and tp. 55-28-Pr. The road ran through dense willow and required so much heavy cutting that it was the end of the year before it was completed.

As the settlers in Carrot River settlement began to complain that their lots were too long and too narrow, it was decided to revert to the customary subdivision survey in range 30 and west of that. This change was for the better for not only did the survey cost less, but a larger number of settlers will be attracted by the square lots offering more river frontage and presenting a larger area suitable for immediate use. In the case of the narrow lots about one-third of the land on an average, is ready for immediate use, another third could be improved by the settler himself while the remainder would have to wait for a general district drainage scheme, to be of use. On the other hand giving the settler a square lot will in many cases give him an area, the most of which can be used without further improvement except ditching or draining which he can do himself.

The survey of timber berth No. 920 completed the season's work.

The floods which are mentioned above are from two sources. When the water in the Saskatchewan rises to a certain level it dams the water in Carrot and Opasquia rivers and then these flow for some distance towards their sources. This causes the flooding of Saskeram and Opasquia lakes and the land which surrounds them, which is very level. The influence of this flood, so far as the Carrot is concerned practically

ceases at the east boundary of range 29, and the country west of this line along the river is quite safe. This flooding of the Saskatchewan occurs about every seven years, although it has flooded recently two years in succession, (1915 and 1916).

Very heavy rains in the spring coupled with a good snow fall in the Opasquia hills, will cause the Carrot to overflow its banks as happened in 1916, and as the banks are the highest part of the land, the country behind is gradually filled up, so that what ordinarily are fine hay meadows become small lakes. Many of these could be emptied as soon as the waters assuage, by means of small local ditches to the river. Settlers are inclined to the opinion that the boom of the Finger Lumber Co. in the river aggravates this flood and that last season they would have been safe if the water had not been dammed back by log jams. This flood caused almost a complete cessation of settlement last summer, but the floods of the Saskatchewan affecting only ranges 27 and 28 are making the settlers go west of these points. It is said that the flood of Carrot river occurs about every fifteen years.

The only farming done last season was the cutting of about 200 tons of hay by one settler and the keeping of about 100 head of cattle by another, this however in spite of the flood which drove about a dozen settlers from their homes. The soil is first-class clay loam absolutely free from stones. The class of buildings being erected is much better than is usually found amongst the first settlers, and many of the men are married and have families. There is a church on lot 60 and if the occasion demands it a school will be conducted there also. Roads are easy to make in winter, but at present the settlers use the river as the only means of communication in summer, many of them being supplied with motor boats.

Every settler there intends to ranch on a small scale, growing enough grain for his own use, and raising garden produce for sale. Cattle will form the chief source of income and this is due to the immense amount of hay which grows in the sloughs adjoining the river. This is of fine quality, often shoulder high and of thick growth.

Lumbering is one of the chief industries at Pas, and the Finger Lumber company own and operate large timber limits along Carrot river, using the stream to drive the logs to the mill. The timber is mainly spruce though there is also some poplar and balm of Gilead. The cut during the winter of 1915-16 amounted to about twenty-eight million feet. Lack of labour is handicapping this industry at present and the cut this season will be considerably less. In normal times about five hundred men are employed at the camps on Carrot river. A large part of the finished product is shipped to the United States.

The past year has seen considerable development in the mining industry north and northwest of Pas, and one company has already begun to ship ore from its properties at Schist lake. There are about one hundred teams at work hauling this from Schist lake to Sturgeon lake where it will be loaded on barges and brought to Pas by steamer in summer. It is intended to ship this to Trail, B.C., for treatment until such time as a smelter can be erected in the vicinity of the mines. It is expected that 150 tons of ore will be shipped daily while navigation is open. The ore is so rich that at the present high price of copper, it is estimated that a profit of $75 per ton or more will be realized, even after paying all expenses connected with transportation and recovery. Sixteen million dollars worth of ore have been blocked out to date on this property.

At Herb lake the gold mining has made considerable headway, and a shaft has been sunk fifty-one feet with very encouraging results. Similar progress has been made on properties on either side of this company's holdings and the results in both cases have been very gratifying.

Many prospectors have come into the country and other finds will likely be reported after the snow disappears.

SESSIONAL PAPER No. 25b

SURVEYS BY A. E. GLOVER, D.L.S., IN SMOKY RIVER VALLEY.

It had been decided to freight the supplies for the season's work up Smoky river from the point where it is crossed by the Edmonton Dunvegan and British Columbia railway, but owing to an earlier break-up than usual this plan had to be abandoned. A trail had to be cut out and the supplies packed from this point to the cache at Little Egg lake.

On May 4 work was commenced on the east boundary of tp. 76-25-5 and the part of tp. 75-24-5 outside the timber berth. During May all the supplies were packed from the railroad to the cache, and that was used as a central feeding ground for the horses for the summer, grass being abundant there.

On August 28 after completing the subdivision of tp. 74-24-5, tp. 75-25-5 and part of tp. 74-26-5 and the survey of the east boundaries of tp. 76-26-5 and part of tp. 75-26-5, the outfit was moved northwesterly across Smoky river and on the 30th the subdivision of tp. 76-3-6 was commenced. That township, tp. 75-3-6 and survey of the east boundary of tp. 74-3-6 were completed before the close of operations on November 5.

The area surveyed east of Smoky river has suffered much from fires, and nearly all of the country is covered by great quantities of partly burned fallen timber. In places where there have been no recent fires the windfall is very dense, being almost impassable in places. In this part of the country great difficulty was experienced in getting good pack-trails, for it meant a vast amount of work to get a pack-train through. Although a few patches of green timber still remain there is not enough outside of the timber limits to be of any merchantable value. As a result of the many fires the best of the soil has been burned, so that it is not first class from an agricultural view-point. A heavy frost was experienced on the night of August 9.

SURVEYS BY J. E. JACKSON, D.L.S., ALONG THE EASTERN SHORE OF LAKE WINNIPEG.

The subdivision work performed by Mr. Jackson extended along the eastern shore of lake Winnipeg from township 28 to township 32 inclusive.

Work was begun in tp. 28-7-E., the party and outfit reaching there by boat from Selkirk. As all the work lay along the shore of the lake, transportation was effected by boat, except the N. by. tp. 30-7-E. which was reached by a flying camp.

The transport outfit consisted of one twenty-foot cedar boat, four large nineteen-foot Peterborough canoes and two smaller Peterborough canoes; with these it was possible to move the whole camp at one trip. The lake was often very rough, but by planning to move camp a day or two before it was really necessary, very little time was lost on that account.

The shore of lake Winnipeg in townships 28 and 29, range 7, consists of a series of low rocky points with sandy bays between. The shore of the lake in the remainder of the district consists of high granite rock with only occasional sandy bays. The water near the shore is usually deep, though in places there are large boulders for a considerable distance from the shore, making it dangerous for large tugs. Tugs can land, however, at Loon straits and at the stone quarry in the northwest quarter of section 30, township 30.

There are very few inland lakes in this district, the only important one being a marshy lake, three to five feet deep surrounded by hay meadow, and occupying about half of section 28, township 29.

Bloodvein river flows through the northeast corner of townships 31 and 32, range 6, into lake Winnipeg. It is from twenty to twenty-five chains wide near the mouth and narrows to from five to eight chains in width in this township. It is from twenty to forty feet deep in the centre for several miles up from the mouth and is navigable for fairly large sail boats for six or seven miles, and for canoes and row boats for many

miles beyond this. The first rapids where it is necessary to tow a canoe is near the northeast corner of township 31, range 6. In crossing range 7, there are a number of rapids from which considerable water-power could be developed, but the river is navigable for canoes for many miles, and except at the rapids has very little current at low water.

A number of small creeks, about one mile in length flow into Iake Winnipeg. These creeks are usually crooked with very little current, and are from three to six feet deep. Loon river crosses Indian reserve No. 11. At its mouth it is from three to five chains in width and narrows to about one-half chain at the east boundary of the reserve.

The land in this district is generally rocky, consisting of a series of rocky ridges covered with jack pine and clay loam covered with spruce and poplar or swamp between. In some townships these rocky ridges occupy about one-half of the area, while generally from one-fifth to one-third of the area is taken up with them. There is some splendid spruce and poplar, suitable for lumbering.

In general this district is not adapted for farming on a large scale, but on account of its location near the lake and rivers, it is suitable for settlement by fishermen who would make their homes on it and develop it gradually while for a considerable time they could make the principal part of their living out of fishing. The land where not rocky could be easily drained and when cleared will make good farm land. There are some good farming areas in township 29, range 7, and township 32, range 6. On the island at Loon straits some excellent oats and barley grew which ripened very early and turned out well. Some first-class vegetables grew there and also at the mouth of Bloodvein river. These vegetables were not frozen in October.

Of the industries likely to succeed, fishing is the chief one at present, and will continue to be an important industry for many years. Sturgeon, whitefish, pickerel, jackfish and tullibee are very plentiful in this part of the lake and the fishing is done on a large scale. Stone-quarrying has already been carried on to some extent in township 30, range 7, and could be carried on to almost unlimited extent. Lumbering in a number of parts will be an important industry as well as pulp manufacturing. Farming in some of the less rocky parts of this district will be an important industry when the country becomes cleared up, as the land where not rocky is all good and the district is exceptionally free from summer frosts. Very few hay meadows were noticed, so that stock raising would be somewhat difficult for a time.

No traces of minerals were found in the district, but a number of veins of quartz were seen, though no gold was discovered.

Surveys by J. H. Johnston, D.L.S., in Peace River Valley.

The work of Mr. Johnston consisted of the survey of township 88, range 19; part of township 87, range 19; townships 86, ranges 16, 17, and 18; townships 82 and 85, range 18; the east outlines of townships 85, 87, and 88, ranges 16, 17, and 18; and the east outlines of townships 83 and 84, range 18; all west of the Fifth meridian.

Arrangements were made for the building of a cache in the northern part of township 86, range 19, as that was the most convenient point from which a road could be cut to Peace river. Two loads of supplies and oats were freighted in on a road, which had been cut out the previous season and which branches from the Grouard road about four miles east of the town of Peace River. This is a good road and during the season was used by settlers as a main road into this district. It passes through townships 82 and 83, range 20, and townships 84, 85, 86, and 87, range 19. The remainder of the supplies were sent down the river in a scow to township 86, and a wagon road cut from this point to the cache in range 19.

The survey was commenced on May 19 and on June 14 the subdivision of township 88 and the remaining third of township 87, range 19, was completed. Township

86, range 18, and townships 86, ranges 16, 17, and 18 were subsequently surveyed. This was done by running the east outlines of townships 85, ranges 16, 17, and 18, and subdividing the south halves of townships, 86, ranges 18, 17, and 16, always moving the camp eastward, returning westward through the northern portions of the townships and thus completing the subdivision and running the east outlines of townships 87 and 88, ranges 16, 17, and 18.

All these townships are very suitable for mixed farming. The soil varies from three inches to eight inches of black loam on a clay subsoil, and the surface is gently rolling with a general slope to Cadotte river except township 82, range 18, which has a general slope southwesterly to North Heart river and is covered mostly with scrub poplar. Some heavy timber was found in the southerly third of township 86, range 16, the southeasterly portion of township 85, range 18, and the northerly portion of township 82, range 18. This timber is mostly spruce and is suitable for lumbering purposes.

In township 86, range 17, there are several large hay meadows, and each season large quantities of hay are cut by settlers for their stock during the winter.

Cadotte river runs through townships 86, ranges 16 and 18, and townships 87 and 88, range 19. The river is from seventy to one hundred feet wide and from two to four feet deep. Its source is in Cadotte lake, which is three miles long by two miles wide, and is located in the southeast portion of township 86, range 16. Its valley averages approximately one hundred and twenty feet deep and one-half mile wide. The slopes of the valley are more or less rough and are covered with light brush, while an abundance of luxuriant grasses grow over these slopes and on the flats along the river, thus affording fine grazing lands for stock.

The climate was ideal for the raising of grain. A few light frosts were experienced but these will disappear with the cultivation of the land.

During the subdivision of these townships the traversing of Cadotte river was left until the ice had formed. In many places along the banks of the river very thick willow has grown and on account of the river being so crooked, it was impossible to make the traverse during the summer in reasonable time. This work was begun on December 3 with a party of four men, and was completed on the 15th.

Surveys by R. H. Knight, D.L.S., along the Alberta and Great Waterways Railway.

Subdivision was begun in the easterly third of tp. 80-7-4 on May 4, and Mr. Knight's party worked southwards, surveying portions of townships 79 and 78, range 7 and the westerly one-third of township 79, range 6. The party then moved north to the 21st base line and commenced subdividing northward in the following order,—the easterly third of township 81, range 7; the easterly two-thirds of township 81, range 6; the whole of township 82, range 6; the westerly two-thirds of township 83, range 6; and a portion of the southwest part of township 84, range 6. This work was completed on August 31, after which the party subdivided the west half of township 85, range 7, that portion of township 86, range 7, lying south of Gregoire lake, the northeasterly part of township 84, range 6, and the west half of township 84, range 5. Water areas were traversed in townships 76, 77, and 78, range 7; townships 75, 76, and 77, range 8; townships 73, 74, and 75, range 9; and township 73, range 10, all west of Fourth meridian. This traverse work was commenced in township 78, range 7 and was proceeded with towards the south, ending in township 73, range 10, on November 24.

During the season about 400 miles of section line was surveyed and about 130 miles of lake and river traverse was made. The work was along and adjacent to the Alberta and Great Waterways railway, and at no point did the surveys extend farther than six miles from the railway. The land generally was gently rolling or nearly level and was covered throughout with timber. The average size of the timber was

from six to ten inches in diameter and consisted of poplar about sixty-five per cent; spruce twenty per cent; jack pine ten per cent; and tamarack and birch about five per cent. About seventy per cent of the country has a soil consisting of approximately six inches of humus and black loam with a subsoil of clay or clay loam. About twenty per cent of the land surveyed was swamp lands or muskeg, the soil of which is largely black muck and peaty materials. On the remainder the soil is light, being sand or light sandy clay, and found generally in the jack pine areas.

There was no hay of any consequence seen, but horse feed was always plentiful within a short distance of any camping places, and upon any small openings in the woods there was always signs of abundant growth.

Only a few lakes were encountered in the subdivision area, and all were small excepting Gregoire lake, which is about nine miles long and four miles wide. This lake contains large quantities of whitefish as well as jackfish. Numerous small streams crossed the land surveyed, and the country as a whole is fairly well drained. Nearly all of the swamp lands and muskegs could be drained into the nearby creeks, and if these lands were drained and cleared a rich fertile soil would result. Seven streams ranging from twenty-five to forty feet wide, about two feet deep, and with a current of about three miles per hour, flowed through the district. These streams together with their numerous smaller streams drain a large tract of country. They were locally known as Waddell and Pony creeks, Kettle river, Cottonwood creek, Meadow creek, Georges river, and Gregoire river. These streams all empty into Christina river, and have their origin in a high plateau known as Little Rocky mountains, which extend in a north and south direction and are situated just to the west of the lands surveyed. Christina river touched only one quarter-section surveyed, namely the southeast quarter of section 5, township 79, range 6. At the time of survey (early in June) the river was about two hundred and twenty feet wide, three feet deep, and had a current of three miles per hour. It is not navigable except by canoes, as it is shallow and full of rapids. The country is best suited for mixed farming, but settlement will be slow, since the land will all have to be cleared before it can be cultivated.

The climate seems to be about the same as that of the Edmonton district. During the months of July and August the weather was very hot and depressing at times. Light frosts occurred near the end of August, but these were partly due to the timbered nature of the country, together with the effect of the undrained muskegs.

Surveys by P. M. H. LeBlanc, D.L.S., in Northern Manitoba.

The subdivision of the western third of tp. 57-27-Pr. was Mr. LeBlanc's first work of the season. The party then moved to tp. 57-29-Pr., where the east and west thirds were subdivided. After completing these parts, work in the township was discontinued, as the central portion was too wet. The next surveys were near Moose lake, where work was done in tps. 53, 54, 55, and 56-20-Pr., and tps. 53, 54, 55, and 56-21-Pr. Indian Reserve No. 31F, situated on the east side of Moose river and at the south end of Moose lake, was also surveyed. As the country was still flooded and water covered the lands adjoining Traders and Lenore lakes, the traverse was postponed until winter.

On October 6 the party returned to Barrier lake via Pas and completed the subdivision of township 57, range 29, the survey of the north outline of township 57, range 28, and the traverse in township 57, range 27. The survey of a location line for a winter road between Barrier and Namew lakes occupied the party from December 4 to the 13th. This completed the season's work except the traverse at Traders lake, which was finished on December 21.

The country passed over during the season may be described as level in the low land, mostly covered with willow and balm of Gilead, while the ridges of limestone formation are generally rolling and covered with jack pine, spruce, and poplar. In

the vicinity of Moose lake the timber has been mostly fire-killed. In township 57, range 29, jack pine and spruce are found in good quantities on the ridges north of Barrier lake, and could be used for ties and lumbering purposes.

The soil of the low land is practically all alluvial, consisting of sediment carried down by the rivers, and will be found very suitable for farming when the country is drained. The soil on the ridges consists of clay of variable depths suitable for mixed farming. In some places erosions of limestone are seen.

Saskatchewan river flows through townships 57, ranges 27, 28, and 29, in a meandering course; its width varies from sixteen to thirty chains and its depth is from ten to thirty feet with a current averaging three miles an hour; it rises so high in the months of June, July, and August that the water overflows the surrounding country, rendering it useless for agriculture. In seasons of moderate floods the banks of this river are above high water, but there are occasional openings in them which allow the water to pass into the interior where the ground is much lower. In very high water, as in 1915 and 1916 the banks were covered for miles to a depth of two feet.

The banks are of clay and although they are what may be called "cut banks," and subject to a certain amount of caving during high floods, they are timbered with large willow and bluffs of balm of Gilead and elm, with willow in the background. If the Saskatchewan and Summerberry rivers were lowered and the floods thus prevented, some very good farm lands could be reclaimed. An extended study of this part of the country would be required before a decision could be given as to the possibility of its being drained.

Moose lake is a large body of water with very large and deep bays, though the water along the west and south shores is quite shallow. Except where the ridges end at the lake, the shores for the most part are low and lead out into muskegs. The south shore is affected to a considerable extent by sediment deposited by Moose river which forms a bar of mud and is a menace to navigation. The lake is navigable by small boats but it is not safe to attempt to cross the main body in canoes as high winds are very prevalent in this district.

At the period of low water Moose lake empties into Summerberry river through Moose river, which never freezes in winter; at high water the procedure is reversed and the Summerberry empties a portion of its waters into Moose lake.

Saskeram, Barrier, Reader, and Traders lakes are expansions of the Saskatchewan and Summerberry rivers. In the summer months they have a depth of from two to twelve feet, while in winter they are nearly dry. There are also numerous lakes, ponds, sloughs and open grass lands, the latter being subject to flooding. All the lakes, rivers and marshes contain fresh water.

The rivers are all navigable and steamboats ply up stream from Pas on Saskatchewan river, Cumberland lake and Namew lake as far as the mouth of Sturgeon-Weir river and down stream on Saskatchewan, Summerberry, and Moose rivers to the entrance of Moose lake in township 54, range 20.

Hay is abundant in the eastern part of township 54, range 20, and large hay marshes can also be found in township 57, range 27, but these are flooded every summer at the time of haymaking.

In winter, fishing is carried on extensively in Moose lake and in all the lakes in the vicinity of Pas and along with trapping is still the main occupation of the inhabitants.

Moose and deer are still abundant, and ducks are plentiful, while fur-bearing animals consisting of foxes, fishers, lynx, minks, weasels, and muskrats are trapped in large numbers every winter. No summer frosts were noticed before September 10.

SURVEYS BY A. LIGHTHALL, D.L.S., IN PEACE RIVER DISTRICT NEAR DUNVEGAN.

The survey party was organized by Mr. Lighthall at Edmonton, and on May 1 left for Spirit River, arriving there the following day. This town is built at the railway station which unfortunately is about three miles from the original settlement on the river. It is in the centre of a fine farming country and in time should become an important place; although quite new it already has a population of about five hundred.

On May 3 work was begun in tp. 79-1-6 and was continued without interruption through townships 78 and 79, ranges 1 and 2, and parts of townships 77, ranges 1, 2, and 3 the whole block being completed on August 19.

When this land is thrown open it is likely to be taken up very rapidly by settlers. The railroad runs nearly east and west through townships 78, ranges 1 and 2, and the old wagon road between Grouard and Spirit River runs almost parallel to the railroad and about two miles south of it, so that the place is easily accessible. On the south side of the railroad there is considerable open prairie land and nearly all of this is already occupied by squatters. North of the railroad the bush is heavier, consisting mainly of poplar up to ten inches in diameter, and farther north towards Peace river the ravines along the streams get deeper and deeper, so that this portion is not quite so attractive as that farther south. The soil everywhere is excellent, consisting of a heavy clay with here and there a trace of sand. There are no muskegs and the sloughs are just about numerous enough to furnish a supply of water. As grass is abundant and as there is enough summer feed even in the timbered areas to support a large number of cattle, the district will probably develop into a dairy country. Stock raising on a large scale however, cannot be carried on until sufficient land is cultivated to produce the necessary amount of winter feed, as putting up wild grass for hay cannot be depended on, and stock cannot find their own feed in winter.

After finishing this subdivision the party moved back by the wagon road to Spirit River, and thence north about four miles to township 79, range 6. The road lay through country that is almost all occupied by settlers who have considerable grain crops and judging by the amount of breaking being done it will be a fine grain-growing district in a year or two.

Subdivision was started in township 79, range 6, and continued through townships 79 and 80, ranges 6 and 7 until the end of October. This block of land is at present somewhat cut off from Spirit River by Ksituan creek, which runs in an easterly direction through townships 79, ranges 7 and 6. The creek, like all the other streams in this locality, has hollowed out a deep ravine with steep banks, and until a wagon road has been constructed across it, settlement to the north of the creek will not proceed very fast. It is crossed at present by the old Pouce Coupe pack-trail, which runs northwesterly through township 79, range 7. Once across this creek it is easy to travel in almost any direction, as the timber is not heavy. The heaviest timber is found on the east side of range 6, and it gets gradually lighter towards the west. In the western part of township 80, range 7, there is a considerable tract of open grass land, which also extends into range 8, although the subdivision was not carried that far. This area, like the one subdivided earlier, will likely develop into a dairying district. Grass is abundant for summer feed, but the setttlers will have to develop the land enough to provide winter feed, as the supply of wild grass which can be put up for hay is not very great. The soil is everywhere very suitable for farming purposes, being a heavy clay loam. There are no muskegs, and not more than enough sloughs to provide a supply of water. This season was a little drier than usual, and water was none too plentiful, especially as the water in Ksituan creek is hardly fit for use, being strongly impregnated with iron and other minerals.

The climate is wonderfully mild for this latitude. The new grass was fairly well advanced on the first of May, and about the last of October there was still no difficulty

for stock to find enough feed. A heavy frost on August 9 spoiled the potatoes and other vegetables, and caused a serious shrinkage in the grain crops, but old timers say that this was very unusual. There was no further frost as heavy as this one until the last of September, and none of the streams were frozen up on November 1.

Surveys by D. F. McEwen, D.L.S., Southwest of Lesser Slave Lake.

Mr. McEwen's work consisted of the subdivision of tps. 69, 70, and 71-19-5; tps. 69 and 70-20-5; tp. 69-21-5; the south third of tp. 72-18-5; and the north third of tp. 71-18-5.

The season's supplies were unloaded at Aggie, a station on the Edmonton Dunvegan, and British Columbia railway, about five miles west of High Prairie, and were transferred over the summer road between High Prairie and Sturgeon lake by wagon and pack train as far as Little Smoky river, where a cache was made. From there a pack trail was cut to Snipe lake, and later the supplies were transferred to that point by pack train. The road between High Prairie and Sturgeon lake is in fair condition during continued dry weather, but is next to impassable after the frost comes out of the ground in the spring and during wet weather. An alternative route from High Prairie, which was used later in the summer, is over the winter road between Grouard and Sturgeon lake. This road passes across Snipe lake, and is well travelled throughout the winter. During the summer it is only suitable for packhorses, as in some places it crosses swampy ground. In summer the northwestern shore of the lake is followed, but the trail is not very good.

Snipe lake occupies about seven sections in the southeast corner of township 71, range 19, and less than two sections in the northeast corner of township 70. The outlet is from the northern end through Snipe creek into Little Smoky river. The height of land between Snipe lake and Carrot river, which flows northwesterly through township 69, range 19, lies in sections 27, 21, 16, 9, 4, 3, and 2 in township 70, range 19, and along the north boundary of section 36 in township 69. Both these townships are high, with a gently rolling surface, cut by the narrow ravines of numerous small creeks, which give good drainage, so that there is no swampy land.

Carrot river after leaving township 69 flows west across the north part of township 69, range 20, and the south half of section 6 in township 70. It is only a small stream from thirty to thirty-five feet wide, with an average depth of about a foot. The surface of townships 69 and 70 in range 20 is nearly level, and in the former township a muskeg of about three sections in extent is located on the height of land between Carrot and Goose rivers. As there is a good fall in both directions, it will be easily drained. In the southwestern part of the latter township there is also a large muskeg.

Little Smoky river enters township 69, range 21, in section 6, and leaves from section 18. It is four chains wide, and was from two to five feet deep when surveyed in October. It has a sandy bottom and steep banks from ten to fifteen feet high. The valley is half a mile wide and forty feet below the surrounding country. Goose river, which also flows through the southwest quarter of the township, enters the Little Smoky in section 7. It is two chains wide, with a gravelly bottom, and steep banks ten to twenty feet high. Its valley is a little wider than that of the Smoky, and increases in depth up stream to over one hundred feet.

The surface of this township outside of the valleys of these rivers is nearly level. The northwestern portion of the township is muskeg, but a good outlet for drainage is afforded by Little Smoky river.

All the area surveyed is timbered with spruce, white poplar, and balm of Gilead up to two feet and over in diameter, and some birch, with willow, alder, birch, and small spruce on the swampy land. There is a fair percentage of good spruce for lumbering throughout, but the most of this is covered by timber berths. Outside the berths,

however, there is plenty of timber suitable for lumber to supply all local demands. Spruce and poplar suitable for pulpwood is also plentiful.

The soil over the whole area, outside of the few muskegs, is a rich black loam from five to eight inches deep, with a clay subsoil being well suited for all the agricultural productions for which the northern part of the province is noted.

Surveys by P. J. McGarry, D.L.S., Northwest of Big River, Saskatchewan.

The work on which Mr. McGarry was employed consisted of the subdivision of the townships between Cowan lake and lake De Laronde from the 15th to the 16th base line.

On May 1 work was commenced in tp. 57-8-3 and all the lands in this township lying outside the timber berths were surveyed. The southern two-thirds of tp. 58-8-3 was then subdivided, and on July 3 camp was moved across De Laronde lake and surveys carried on in tp. 58-7-3. The remaining subdivision was then done in the following order; tp. 60-8-3; tp. 60-9-3; tp. 59-9-3; and tp. 59-8-3, work being completed on November 1.

The whole area surveyed, with the exception of tp. 58-7-3, is nearly level or very gently rolling. The land is low and covered with a great number of small lakes. Surrounding these lakes and along the small streams and creeks flowing between them there are many large hay meadows, but the rest of the land is wooded, chiefly with poplar and spruce. Outside the timber berths the trees are usually small although in some areas large spruce were found up to twenty-four inches in diameter. There is also a considerable quantity of scattered birch, tamarack, jack pine and willow.

In its general character the country is best suited for cattle raising and mixed farming. With the exception of the large muskeg area near the 16th base line in the vicinity of Taggart lake and lac Voisin, practically all the land surveyed is suitable for settlement. Large herds of cattle could be grazed on the numerous hay meadows and sloughs and the settler should have very little difficulty in harvesting sufficient wild hay to feed his stock during the winter. During the season a settler located in a meadow near the south end of Taggart lake. He brought in about fifty head of cattle, and seven or eight horses, which were in excellent condition in November. The good land is however covered with a growth of small spruce and poplar which will have to be cleared and this may prevent an early setttlement in the district.

The climate is practically the same as that prevailing in the districts around Prince Albert and Saskatoon. No frosts were experienced at an earlier date than they were reported from the prairies to the south. The rainfall was exceedingly great, and last season was unusually wet.

The facilities for travel to and from the district are exceptionally good. No quarter-section surveyed is more than about thirty miles distant from Big River, a thriving little lumbering town of about five hundred population. This town is on a branch line of the Canadian Northern railway, distant eighty-three miles from the city of Prince Albert. A mixed freight and passenger train makes three trips weekly to and from the city. During the past season, on account of the exceptionally wet weather, the roads out of Big River became almost impassable for teams hauling more than a few hundred pounds. It is reported that in an ordinary dry season, places which were absolutely impassable during the past year could be crossed with little difficulty. If this is the case, no difficulty should be experienced in taking a good load over the road leading from Big River to the north end of Taggart lake. For land adjacent to them, boats could be conveniently used on both Taggart lake and lake De Laronde.

In practically all the area surveyed the soil is good, consisting of a few inches of humus with clay subsoil. There are very few jack pine ridges with the accompanying light worthless soil.

An abundance of good drinking water can be had almost anywhere. Nearly all the lakes contain good clear fresh water, and, in places not sufficiently close to use the lake supply, water may be had at a depth of a few feet.

Large game in the district is exceedingly plentiful. Rarely a day passed that moose or deer were not seen by some member of the party, and in tp. 60-10-3 large herds of cariboo were often seen. The larger lakes are teeming with fish, whitefish, pike, and pickerel being the chief varieties. In the fall large flocks of ducks were commonly seen on these lakes and more particularly around the very small lakes and ponds. Fur-bearing animals are none too plentiful, but a few red foxes were seen.

There are no minerals of economic value in the district, and no stone for building or any other purpose is available.

Good building timber, sufficient for the use of any settler, can be had almost anywhere, and good wood for fuel is plentiful, but no deposits of coal are reported in this or the adjacent districts.

Surveys by W. H. Norrish, D.L.S., Northeast of Fort à La Corne, Saskatchewan.

Mr. Norrish's surveys consisted of the subdivision of tp. 53-13-2; tp. 53-14-2; tp. 53-15-2; and parts of tp. 53-12-2; tp. 54-14-2; and tp. 54-15-2.

Although not very far north of settlement the district presented some difficulties in transportation. There were three possible routes to the location of the surveys. The first was to float down Saskatchewan river on scows to the vicinity of Birch island in tp. 53-12-2. The second was to go north by trail from Star City or Tisdale on the Canadian Northern railway and cross Saskatchewan river near Ravine Bank post office. The third route was to go northeast from Prince Albert along the Candle lake trail and then branch to the east along a trail used by the surveyors on the Hudson Bay railway survey.

The third route was first rejected as the trail was reported to be in very bad shape, being very wet and only fit for winter traffic, with bad crossing places on Whitefox river and Bisset creek. The Saskatchewan river route is feasible if scows are run down the river on the high water which occurs in the latter part of June or the early part of July. At other times it would be very risky, though it might be possible to go down the river immediately after the ice went out. The water is known to drop rapidly very soon after the ice goes out and is usually quite low during the month of May. This scheme was impossible as the ice went out before the party was organized.

The main obstacle in the navigation of this part of Saskatchewan river is Cole falls, which are situated about thirty miles below Prince Albert. Below the falls there are rapids for about eighteen miles. According to reports the river at the falls and in these rapids is full of boulders which are hard to miss when the water is low. Cadotte and Nipawin rapids farther down the river are not so hard to navigate, but there are a large number of sandbars in the river which are constantly shifting.

A few years ago the Saskatchewan was used considerably for transportation purposes, but now there is scarcely any use made of the river except for canoes and small boats. The main difficulty in coming up the river from Pas is experienced in Tobin rapids, which are very shallow, being not over a foot deep at times.

The route followed was north from Tisdale as the road from there to Ravine Bank post office was graded most of the way. From Ravine Bank a scow was used on Saskatchewan river to transport the supplies and the packhorses were taken down the north side of the river.

The country between Tisdale and the Saskatchewan is fairly thickly settled. It has been for the most part lightly wooded, though in some places there is a good growth of poplar. The best land is situated around Lost River, Nipawin, and Ravine

Bank post offices, within a few miles of the Saskatchewan. In fact this is a very fine tract of agricultural land, extending for about twenty-five miles along the river and from three to six miles in breadth. It is mostly gently rolling country and was lightly wooded with small poplar and scrub, with jack pine on the lower flats adjacent to the river. Fires in recent years have burned over most of the country and have given great assistance in clearing the land, while they do not seem to have damaged the soil to any noticeable extent. Reports of this good land have spread throughout the province of Saskatchewan and settlement is spreading to the north side of the Saskatchewan where more than eighty quarter-sections have already been taken up. Considerable quantities of wheat and oats have already been grown in this settlement. During the winter the farmers are kept busy hauling their grain to Tisdale and Star City, a haul of from thirty to forty-five miles. This long haul is at present the greatest drawback to the development of this stretch of country. The district is also well suited to stock-raising, and I have noticed large areas of abundant grass which remained unused. The main reason why more stock is not raised seems to be due to the amount of money required to buy good stock and on account of the length of time which elapses before there is any return.

Torch river in tp. 53-12-2 is from two to four chains in width, three to ten feet in depth and has a current of three to five miles per hour. There are several sections of good land along the river in this township, and also a large willow swamp which would make good agricultural land if drained. As the water is backed up by beaver dams and as the area is close to Torch river this could be easily accomplished.

Between Torch and Saskatchewan rivers the country consists of rolling jack pine areas and spruce and tamarack swamps. Along Saskatchewan river considerable areas of fine white spruce grow up to thirty-six inches in diameter. These areas have, however, all been included in several timber berths which lie along the river. The valley of Saskatchewan river is from 150 to 175 feet in depth.

The valley of Torch river is from 60 to 100 feet deep, and the land along the river is rolling and wooded with poplar, jack pine and spruce, with some birch, alder and willow. Some distance back from the river are to be found a number of sloughs and swamps wooded with black spruce and tamarack. Some of the poplar areas in tp. 53-13-2 and tp. 53-14-2 have very fair agricultural land, but the largest and best areas of agricultural lands were found farther north. Most of tp. 53-15-2 and the portions of tp. 54-15-2 and tp. 54-14-2 which were subdivided were first-class land, though they are rather heavily wooded with poplar and spruce.

Small patches of large white spruce were noticed along the banks of Torch river in tp. 53-13-2 and tp. 53-14-2, but they were not large enough to be important. Along the westerly boundary of tp. 53-15-2 considerable areas of fine large white spruce up to thirty-six inches in diameter were encountered which extended westerly into tp. 53-16-2. These areas seemed to be mostly included in timber berths. In tp. 54-15-2 there were also large areas of fine white spruce and these again were mostly included in timber berths.

Attention has been directed above to the excellent farming district around Ravine Bank on the south side of the Saskatchewan. The settlement is extending northwards and there seems to be little doubt that the land now being homesteaded on the north side of the river will be just as good. The main obstacle to settling the land on the north side of the river now is the lack of a ferry, though it is practically certain that one will soon be put in near Ravine Bank. Throughout the townships subdivided the levels have indicated that the swamps and sloughs could be easily drained. In a good many cases the water is held back by beaver dams, and by simply breaking these dams the land would be drained. The season was unusually wet and the sloughs were kept full of water, so that large quantities of hay were lost.

These townships will likely be developed as a grain-growing country, though they are perhaps better suited to mixed farming and stock raising. At Ravine Bank

the first frost generally occurs within the last three or four days of August, and is not usually severe enough to damage the crops.

Game is fairly plentiful, deer, moose, elk, and bears being seen, and large colonies of beaver are found in places.

Surveys by J. W. Pierce, D.L.S., in Lower Peace River Valley.

From the town of Peace River Mr. Pierce's party was transported down stream in a scow, arriving at the first work in tp. 97-19-5 on May 17.

The river was open for navigation on May 1, but no steamboats passed down to Fort Vermilion until two days after the party had started work.

At the town of Peace River the valley is about 700 feet deep, but north of this point the depth gradually decreases. At the commencement of the work it is about 500 feet deep, in township 101 about 300 feet, while farther north it becomes still shallower.

As the survey operations were confined to the district immediately adjacent to the river, it was possible to perform probably two-thirds of our work from camps situated on its banks; the usual packhorse outfit was dispensed with and man-packing was used for the small amount of work which was done at a distance from the river. For the operation of the work along the river an outfit of Peterborough canoes with two small portable motors were used to advantage, while the cookery and dining tables were placed under canvas on the scow, which simplified greatly the moving and setting up of camps.

The survey work was completed on October 13, and on the following morning the party left for Peace River on the steamer *Northland Call,* arriving there on the 17th. From there they took train to Edmonton, where the party was disbanded and paid off.

Levelling operations were carried on throughout the work, and the new style of survey monuments were used for the first time. These were found at first a little troublesome to set in place, but it was not long before the party got accustomed to them, and it was found that this monument presented a great deal better appearance than did the old type, besides being of a more permanent nature.

As before noted, Peace river flows through this work in a valley from 300 to 500 feet in depth and from a mile and a quarter to two miles in width. The river itself has a width of from thirty to fifty chains between banks and a rate of possibly three miles per hour. It is filled with numerous islands, all of the same general shape, viz., long and narrow and usually terminating at their lower end in a long narrow point. The larger of these islands are well timbered with cottonwood, poplar, and spruce, while the smaller ones are covered only with willow. About the beginning of July the river is subject to a rise or flood of from ten to sixteen feet, due to the melting of the snow in the mountains. Usually the banks are high enough to protect the adjoining flats from being flooded, but the older inhabitants stated that about twenty years ago the ice became jammed in the spring and that the meadows at Carcajou were all flooded and houses were destroyed. This is of course an exceptional case, but marks were noticed on the trees and driftwood in the bush which verified the fact. During high water the river, which is normally clear and fresh, assumes a dark muddy appearance and is barely fit for use. After about a month of high water, the stream gradually subsides and the water clears up, so that fine broad sand and gravel beaches and bars are exposed on either side of the river, making ideal conditions for stadia traversing.

The most important streams tributary to Peace river in the vicinity of the work were Buffalo and Wolverine rivers. These streams are about one and one-half chains in width, have a depth of fifteen inches at low water, and flow at the rate of six to

seven miles per hour; they are filled with rapids and boulders, and are, of course, not navigable, except possibly for a very short time during high water. These rivers flow through valleys which were nearly as deep as the main river valley itself. Numerous small creeks flow into the river, which run nearly dry in the fall, although the valleys through which they flow are very deep, particularly as they approach the river.

Several steamboat companies operate shallow-draft stern paddle-wheel steamboats on the river between Hudson Hope and Vermilion chutes during the season of navigation between May 15 and October 15. These boats which do not sail on any well-defined time schedule, are well equipped to handle a general freight and passenger trade. Apparently, the greater portion of their trade consists in handling goods for the far North.

On account of the many windings of Peace River and the many deep valleys just referred to, the surface over a great portion of the work was rough and broken and unfit for agricultural purposes, although if the timber were removed, it might be suitable for grazing. Generally, on the east side of the river, away from the river banks, the surface is made up of hills, usually under twenty feet in height, for two or three miles back; the surface then usually changes to large muskegs and sand ridges. An exception to this, however, is worthy of note through the eastern part of township 98, range 19, where there is a flat of about six square miles, its centre being near the northeast corner of section 14. This flat is nearly open and is adapted to grazing, feed being particularly plentiful. On the west side of the river, the work in many places did not extend sufficiently far from the valley to enable the party to form a fair estimate of the country. Along the correction line between townships 98 and 99, the surface is level, and this appears to be the case through the country farther west. Through the parts of townships 100 and 101 on the west side of the river, the surface is rolling, similar to that across the river. The most valuable land was found in the river valley in township 101, range 19. There the top of the valley, instead of following the course of the river, partially cuts across from bend to bend with the result that some large hay meadows are found near the water in sections 5, 6, 15, 16, 30, 31, and 32. Abundant crops of hay grow of which only a small portion is at present being used.

The only permanent inhabitants met are settled in this township mostly in section 30, at what is called Carcajou point. These people are all non-treaty Indians and half-breeds. They have built small houses close together and do a little gardening in addition to hunting and trapping. In the winter months, one or two private fur traders usually put in a stock for fur trading, and it is at this point that supplies for Keg River prairie are delivered by boat in the summer and stored till winter, when they are forwarded across country. There is a Roman Catholic church there, but it has no regular services, and there is no-post office nor school. Across the river from this settlement, an English speaking family who came to the country a year ago, are living and these are the only permanent white people in the district.

In the meadows just referred to, the soil consists of a first-class loam and this was the only desirable soil seen by the party. Generally, on the west side of the river, the soil is sandy clay which would be adapted to agricultural purposes when the timber is cleared away. On the east side of the river, particularly in townships 98, 99, and 100, about fifty per cent of the land is worthless for agriculture, having a subsoil composed of sand, with a very light surface soil of loam and decayed vegetation. About twenty-five per cent is muskeg where the soil is first-class loam, but in order to utilize it, extensive drainage operations would have to be undergone. The remaining twenty-five per cent is sandy clay.

On account of the proximity of this district to the river which is the only route for travelling, fires, presumably originating from camps, are so often started that very little of the original timber is now standing. What is left is to be found on the islands and in narrow fringes in the bottom of the valleys of Peace river and tributary streams.

This consists of a good quality of spruce and poplar from twelve to twenty inches in diameter and it is now being used as steamboat fuel by the navigation companies. On the north side of the river in townships 98 and 99, range 19, a considerable stand of this timber has escaped destruction. In township 98, south of the river and in township 100, east of the river, there are a few stands of jack pine of a size and quality suitable for tie timber. Otherwise, except for muskegs where the timber is very small, the rest is principally brulé and windfall, and is now growing up in scrub poplar.

Cool nights and hot days with occasional frosts appear to be characteristic of this country during the summer months. On account of the length of daylight, vegetation is very rapid, and at Carcajou point the usual garden produce had fully matured without injury from frost, although it had received very slight attention.

Bears are particularly common and they with moose form a substantial part of the sustenance of the inhabitants, there being no fish in the river. All the common fur-bearing animals are found there, especially the various kinds of foxes, beavers, otter, marten, and mink.

Surveys by F. V. Seibert, D.L.S., Southeast of Lac La Biche.

The block of land comprising townships 65, ranges 6 to 9, townships 66, ranges 8 and 9, and the southerly two-thirds of townships 66, ranges 6 and 7, all west of the Fourth meridian, were subdivided by Mr. Seibert last season.

The party reached the east shore of Pinehurst lake, in township 65, range 9, the evening of May 2, using wagons accompanied by packhorses and travelling by way of Normandeau. A shorter trail, not so good, however, for summer travel, follows the south shore of Beaver lake and meets the trail used about the centre of township 65, range 11. The easterly half of these trails is very hilly and the valleys are too wet for good wagon travel after the frost leaves the ground.

Another wagon trail from Vegreville to this place passes through St. Paul de Metis. This trail is better than the one followed but has the disadvantage of being longer, it would have made a difference of from two to three days in the time of getting to the work. The better trail is the one by St. Paul de Metis, as it is used more and kept in better condition. Automobiles travel as far as Bordenave, twenty miles north of St. Paul de Metis.

On May 3 work was begun in township 65, range 9, and on September 25, with the exception of the traverse and some lines around Wolf lake, in townships 66, ranges 6 and 7, which could be better done on the ice, the work planned for was completed.

On November 27 when the ice had sufficiently formed on the lakes a small party and two teams returned to the work and completed both the traverse and the work at Wolf lake, returning to Edmonton on December 30.

The country surveyed was mostly good agricultural land; the surface was rolling, and covered with poplar and willow, very little open or hay land being seen. Sand river valley, in range 8, varies from 250 feet to 500 feet in depth, and the river following a winding course down the valley is one of the finest streams in the north. With a clean sand bottom it could be forded almost any place except at extremely high water. Two large lakes. Worm lake in township 66, range 9, and Wolf lake in townships 66, ranges 6 and 7, contain many fish. Worm lake appeared to have only jackfish, and no outlet was noted, although a dry creek bed north to Mosquito lake may have been an outlet at one time. Wolf lake has an abundance of whitefish, pickerel, and jackfish.

Very little good timber was seen, but no minerals were noted.

Moose and deer are plentiful, but fur-bearing animals are not abundant, probably due as much as anything to the scarcity of rabbits.

APPENDIX No. 7.

RAILWAY BELT SURVEYS.

Surveys by J. A. Calder, D.L.S., in the vicinity of Ashcroft, British Columbia.

Mr. Calder's first work was in tp. 23-22-6, where the westerly boundary of Tranquille and the easterly boundary of Arrowstone Forest reserves were run and the subdivision of the remaining lands completed. A certain amount of retracement surveys were also required as several of the original monuments had become obliterated.

The lands surveyed lie along Deadman river. The bottom of the valley varies from a few chains to over half a mile in width and is mostly excellent agricultural land. The hills to the west rise abruptly to a height of about two thousand feet above the river with lofty rock escarpments. Towards the east the ascent is, as a rule, much more moderate and although almost all worthless for farming, there are large areas of fair grazing lands. Practically all the agricultural land along the river has been taken up and some good ranches were noticed. Hay is the chief crop produced but all grains and vegetables do well. Fruit is also grown in a small way with moderate success; irrigation, however, is required and at present this district is best adapted for stock raising.

A good wagon road follows down Deadman river from this township and joins the main road from Kamloops to Ashcroft about five miles south of Savona. A continuation of the former road leads to settlements farther up Deadman river and to upper Criss creek, but it is in bad shape with some long heavy grades. A much more direct road is now under construction from the mouth of Criss creek to the settlements on that creek.

The land in townships 23, ranges 20 and 21 inside the Tranquille Forest reserve, which have been squatted on for a number of years, was next subdivided. This land lies for the most part on a high plateau between Red lake and Criss creek. The inducement to settlement is a number of wild hay meadows ranging from two to twenty-five acres in area, but outside of these meadows the bulk of the land is jack pine country and generally worthless. This district is best adapted for stock as some areas of good pasturage were observed and hay for wintering can be obtained from the meadows. Summer frosts are common, potatoes can hardly be grown, and such small patches of grain as were seen were not promising.

A number of miscellaneous surveys were then commenced in townships 23, ranges 25 and 26, including the resurvey of four miles of the north limit of the railway belt, incorrectly placed by a previous survey, the survey of the westerly boundary of Arrowstone Forest reserve, the easterly boundary of Hat Creek Forest reserve, and the completion of the subdivision of these townships. These were finished about July 20, and the remainder of the season was spent in running the belt limit from the SW. cor. sec. 24, tp. 23-26-6 to the NW. cor. sec. 35, tp. 18-28-6.

On July 31 camp was moved to a point on Maiden creek about seven miles from the Cariboo road. From there fully ten miles of trail over difficult country had to be opened out to the next camp situated a couple of miles northeasterly from Marble canyon. The survey of the belt limit was carried to the edge of the canyon on August 29 where there was a sheer drop of three thousand feet to Pavilion lake. A signal was made on the edge at the nearest point to the line visible from below and the line mounded as far as run. On September 1 the party moved by a circuitous route to the bottom of the canyon. A base line was now laid out and the position of the line in the bottom determined by triangulation.

The country traversed from the Cariboo road to Marble canyon is very mountainous and broken. Save for a flat on Maiden creek, mostly included in Lot 143, G.1, no valuable agricultural land was seen. For about five miles up this creek there is good grazing but the rest of the way it is nearly all timber grass. The land is generally well wooded with heavy fir along the valleys and small to medium size jack pine on the elevated slopes. Towards the canyon large areas have been fire killed, and usually a dense second growth of small jack pine has sprung up making it a very hard country to travel with packhorses.

Marble canyon, a comparatively low pass between Pavilion and Clear mountains, acquires its name from the vertical cliff of limestone, about three thousand feet high, forming its northerly side. On the south, the wall of the canyon is granite, and although steep and in many places precipitous, it does not rise nearly so abruptly. There are two lakes of fresh water in the bottom; Pavilion lake, the largest, although nowhere more than half a mile across is about five miles long, and Crown lake, almost a mile long, was crossed by the line near its westerly end. A small creek, flowing from the south, drops over a cliff about a hundred feet high into this lake.

A good wagon road from Ashcroft to Lillooet passes through the canyon and it is a favourite haunt for motorists in the summer months. The canyon and the lakes and mountains flanking it afford a unique combination of scenic, climatic and other attractions.

Between Marble canyon and Fraser river the belt limit passes over a high range of mountains, the last twelve miles being extremely broken up by deep narrow gorges. The country is mostly wooded with jack pine, considerable fir being found on the lower slopes and in the valleys. Southerly from mount Martley to Chipuin mountain large areas of timber are fire killed, but south of the latter mountain some of the country is open and covered with good grass. Although high, these lands should be valuable for summer range. Several coveys of blue grouse and a few deer were noticed, but game is not plentiful, a condition to be accounted for by a number of timber wolves seen by members of the party. On Rusty creek, a tributary of Fountain creek, several copper claims have been staked and some assessment work done.

On October 12 the line was connected with the portion already run across Fraser valley and work was closed for the season.

Surveys by W. J. Johnston, D.L.S., in the Revelstoke District.

The first work done by Mr. Johnston was a small subdivision survey in tps. 21 and 22-7-6, which was completed on April 21.

His regular season's work consisted of subdividing into legal subdivisions the land lying between Revelstoke and the south limit of the railway belt. As the greater part of this land had already been subdivided into quarter-sections and subsequently homesteaded in forty-acre parcels, the work entailed a considerable amount of retracement. The subdivision was very much needed, as many homesteaders could not locate their boundaries. A large portion of the valley is still held under timber license, but portions suitable for agriculture are gradually being withdrawn and thrown open for entry.

On July 5, the party commenced the survey of seven miles of the railway belt limit, running east from the SE. cor. sec. 33, tp. 20-29-5. This line runs over Mt. Sproat, whose altitude is 8,050 feet. On this work packhorses were hired and a trail had to be cut over the mountain for their use. The work in some places was very slow, owing to the broken and precipitous nature of the country, and the rain and fog on top of the mountain caused a delay of nearly a week. After the completion of this limit, subdivision was continued in the Columbia valley.

The water was very high last season, and as a result the mosquitoes were very bad. On this account the party was forced to disband for twelve days in August, as it was impossible to work to any advantage.

For transportation boats and canoes were used on Columbia river, and as the work lay on both sides of the stream the boats were very useful. The Arrowhead branch of the Canadian Pacific railway runs along the left bank of the river and also affords a good means of transportation.

The land generally speaking is a sandy loam and is adapted for practically any kind of farming, though mixed farming is probably the most suitable. The district is suitable for fruit growing and is especially good for apples. Small fruits and vegetables also grow in abundance. Dairy farming is being taken up by a large number of the older settlers as corn can be grown quite easily.

The land for ten miles south of Revelstoke is settled chiefly by Austrians and Italians. These settlers are gradually improving their holdings, though progress is slow, as the land has been heavily timbered. The bottom lands have been largely burned over, but the side-hills contain some fair timber, chiefly fir, hemlock, and cedar. Roads are gradually being built all over the valley. A trunk road between Arrowhead and Revelstoke is under construction but may not be completed for several years.

With the exception of a fence-post and shingle-bolt camp, there are no lumbering operations being carried on, most of the mills in the adjoining districts having closed down.

The spring season was late and cold with a lot of rain, but there was some very warm weather in June, July and August

On November 10 the party was disbanded at Revelstoke.

Surveys by R. B. McKay. D.L.S., in the vicinity of Chilliwack, British Columbia.

The season's work was begun by Mr. McKay on April 11 by making small surveys in tp. 42 E.C.M. and tp. 4-5-7, in the reclaimed area of Pitt meadows adjoining the south end of Pitt lake. This was completed in a few days after which surveys were commenced in tp. 3-29-6. This township is well settled and mixed farming, dairying, and fruit growing, which are the chief industries have all proven very successful. A saw-mill was in operation in the southeasterly part of the township, where there is still considerable merchantable timber consisting of large fir and cedar. Fraser river runs westerly through this township, and a government ferry makes from three to five daily return trips across the river thus facilitating travel between the northerly and southerly parts of the township.

Small surveys also were made in tp. 24 E.C.M. and tp. 3-30-6, and the traverse of the banks and islands of Fraser river in this vicinity completed. Mixed farming, dairying, and lumbering are engaged in by the settlers in this district. Saw-mills are situated at Harrison Mills and at Deroche, the latter milling cottonwood only, which on account of being odorless is valuable for fruit boxes, etc; dense stands of it are found in the vicinity of the Fraser in these townships.

The party next made subdivision surveys in secs. 5 and 6, tp. 21 E.C.M. This township is very mountainous and the only agricultural land it contains is situated at the southerly limit of the township.

After completing some small surveys in tps. 4-27-6 and 4-28-6, work was begun in tp. 5-26-6. The town of Hope in this township is now served by three railroads, the Canadian Pacific, the Canadian Northern, and the Kettle Valley, and it is a centre for the outlying prospective mining districts. The greater part of this township is mountainous, timbered chiefly with fir, cedar, and hemlock, and there is very little agricultural land available for the prospective settler.

Exploratory and subdivision surveys were made in tp. 2-27-6 extending from the east boundary of section 5, easterly along Chilliwack river and Chilliwack lake, connecting with the limit of the railway belt in tp. 1-26-6. The Chilliwack valley flat through tp. 2-27-6 and 1-26-6 is about one-half mile wide and as a rule is heavily timbered with fir, cedar, and hemlock. The fir is generally of good quality from one and a half to four feet in diameter and is found as large as six feet in diameter. The cedar is of fair quality, and some of it is as large as eight feet in diameter. The hemlock is generally hollow and of little value. There are several areas in the river flat which have been burned over and where reforestation has taken place, but as these places have poor soil and contain numerous large boulders, they are unattractive for agricultural purposes. Some of the heavily timbered areas, however, contain very good soil with sandy loam in patches. Steep rocky mountains rise abruptly from the flat on both sides of Chilliwack river and are timbered with second growth or small scrubby fir, cedar, hemlock, and balsam with small scattered patches of good timber, which latter are generally in inaccessible places. A few large scattered pine were noticed in the river flat. The easterly and westerly sides of Chilliwack lake are bounded by steep rocky mountains which slope abruptly to the lake, and contain no agricultural land. There is a small area of land adjoining the northerly end of the lake which is suitable for settlement.

The next work was in tp. 4-27-6 which is very mountainous and has but little agricultural land. A pack trail runs from the Yale wagon road near Laidlaw up the valley of Wahleach creek to Wahleach lake. From the lake a prospector's trail runs southerly to the foot of the rugged mountains in sec. 4, tp. 3-27-6. The steep mountains on both sides of Wahleach creek and the area surrounding Wahleach lake in tp. 3-27-6 are well timbered with large fir, cedar, and hemlock; the area also contains some large balsam. This timber is included in timber berths which are held to conserve the water supply of Wahleach lake, and plans have been made to develop power from this lake. There are a few patches of land in tp. 3-27-6 which are suitable for raising garden produce.

Surveys in tp. 4-29-6, tp. 2.W.C.M. and tp. 39.W.C.M. completed the operations for the season. At Ioco, in the vicinity of the latter work an oil refining industry has sprung up which employs a considerable number of men.

Surveys by N. C. Stewart, D.L.S., in the vicinity of Donald, British Columbia.

Survey work was begun in tp. 29-23-5, where Mr. Stewart traversed Columbia river and its tributaries, Waitabit and Bluewater rivers, and surveyed most of the land between the Waitabit and Bluewater. The bench land which extends from Golden along the right bank of Columbia river ends at the Bluewater. On this bench between the Bluewater and the Waitabit there is some good agricultural land.

Game is scarce in the immediate vicinity of Donald, but by going into the mountains a few miles, goat and caribou can be found. Some small lakes in the Blackwater a tributary of the Bluewater are famous for trout fishing.

In tp. 24-1-6 the section lines were retraced, the quarter-section lines run and legal subdivision posts established on all lines in sections 3, 4, 11, and 12; the south boundary of Revelstoke park was also surveyed in sections 11 and 13, and Clachnacudainn creek, which forms the boundary of the park in sections 13 and 24, was traversed.

On June 7, legal subdivision surveys were made in the north halves of secs. 31, 32, and 33, tp. 23-1-6 and sec. 5, tp. 24-1-6, and the south boundary of Revelstoke park was established in section 6. Illecillewaet valley is very narrow and the adjoining mountain sides are very steep and rugged. This made the work very hard, especially on the park boundary where often a climb of 2,000 feet was necessary before starting work. The best land in the vicinity of Greely has been taken up and the settlers seem to be progressing although the land is extremely hard to clear. A good wagon road joins this settlement to Revelstoke.

Our next work consisted of the survey of the south boundary of Revelstoke park across secs. 1 and 2, tp. 24-2-6, the survey of the east boundaries of secs. 1 and 3, and the subdivision of sec. 3, tp. 24-1-6 after which the survey of the north limit of the railway belt across Downie creek was begun. The north fork of Downie creek was reached by trail up the north fork of Illecillewaet river from Albert Canyon. This trail was at one time a sleigh road over which the supplies were freighted into the Waverley and Tangier mines which are approximately twenty-eight miles from the railroad.

This part of the belt limit was extremely difficult to survey, for the mountain sides are very steep and broken by ravines and cliffs, and the valleys are heavily timbered and brushy. To add to the topographical difficulties the weather was unfavourable, about fourteen days being lost out of thirty-eight.

The Waverley and Tangier mines have not been worked for about fifteen years and the buildings are in ruins. They are at present too far from transportation to be worked economically. The valley of the north fork of Illecillewaet river is crossed by numerous slides and is therefore not suitable for the site of a road or railroad. As the mines are situated on Downie creek slope, a road will likely be built out to Columbia river. If constructed, such a road would give access not only to the mines but to several million feet of valuable timber.

On September 2 we camped again near Revelstoke in tp. 24-2-6 and from this point sections 3, 4, and parts of sections 9, 10 and 15, were subdivided and the survey made of part of the west boundary of Revelstoke park.

The next work was the stadia traverse of the right bank of Columbia river from Revelstoke to the north limit of the railway belt. This was completed on October 19. The subdivision of the east half of section 5, in tp. 24-2-6 and the traverse of Jordan river in that section completed the season's work.

The Big Bend wagon road up Columbia river from Revelstoke is now completed as far as Twelvemile island. From the end of this road a pack trail is the only means of travel up the Columbia, the steamer having been burned.

With the exception of bears, game is not very plentiful in the vicinity of Revelstoke. At one time Columbia river valley above Revelstoke was famous for caribou and goats, but these animals are scarce at present, the old timers stating that cougars have driven them out of the country. Bears are very numerous especially at Greely and trout fishing is fairly good in Jordan and Illecillewaet rivers.

Surveys by C. H. Taggart, D.L.S., in the Kamloops District.

Mr. Taggart began the season's work in tp. 17-17-6. The lands surveyed in this township lie on the benches above the valley of Trapp and Napier lakes, and are reached by a newly-constructed wagon road, which branches off from the Kamloops—Nicola highway at the northerly end of Trapp lake.

During the season of 1912 a considerable area of land on these benches was surveyed but at that time only one setttler was located there. At the present time, however, nearly all of the quarter-sections which show any indications of workable soil have been taken up. Water for irrigating these lands is not available, and it is yet to be proven whether the settler can make a living from them under the dry-farming method. The lands made available by this season's surveys are all in the eastern portion of the township, and are almost entirely wooded with fir and pine, with scattered willow and poplar.

The next surveys undertaken were in tps. 20 and 21-16-6. This work consisted chiefly of the marking of the boundaries of the Niskonlith Forest reserve, and the retracement and marking of the corners of the Kamloops Indian reserve, No. 1. The subdivision of the lands lying outside of these reserves was completed. Very

little of the land surveyed in these townships is of agricultural value, but it furnishes good feed for stock, and large herds of cattle and bands of horses are ranged over these and the adjoining lands. This stock is owned by the Western Canada Ranching company, who have extensive holdings in the southern portion of township 20, range 16.

The delimitation of the boundaries of the Niskonlith Forest reserve and the subdivision of the unsurveyed lands outside, in the valley of Louis and Fadear creeks, in townships 22, 23, and 24, range 15, and along the valley of Fadear and Cicero creeks in townships 23 and 24, range 14 was the next work. Very little land of agricultural value was made available by these surveys. The agricultural lands of the Louis creek valley consist of two classes, viz., bottom lands and bench lands. In the bottom the soil is mostly rich black loam with gravel subsoil, while on the benches sandy loam or clay with gravel is found. These lands are very productive of hay, grain and root crops while small fruits also do well. Usually abundant moisture is received by rain and dew to bring heavy crops to maturity. In any event the numerous small streams flowing into the bottom from the mountain sides will more than supply the needs should irrigation be required.

Extensive range lands are not to be found in the Louis creek valley, therefore, at present stock raising possibilities are limited. The slopes of the mountains forming this valley are steep; the soil is rich and moist and capable of producing an abundant growth of grass suitable for feed. The wood growth on these slopes is mostly mountain willow with alder, poplar, birch, and a few scattered pine and fir, and is in most places very dense preventing the growth of grass. Cattle, as a rule will not climb to the upper reaches of these slopes for feed, while horses, sheep, and goats will. The cattle will range only on the lower benches, which in this valley are of very small area.

The lands lying in the valleys of Fedear and Cicero creeks in the above-mentioned townships, are also of the two classes, bottom and bench. The former is good rich land mostly of clay loam, while the benches are of sandy loam with gravel subsoil. The lands along the bottom will require much labour to clear and make ready for crop, while the benches will need much less. No irrigation is thought necessary, but it is just possible that in dry seasons it would benefit the land on the beaches.

The development of these valleys has been much delayed for the lack of easy access. At present settlers' effects and supplies have to be packed on horses for some miles. A good wagon road is possible and has been started, and the settlers in the vicinity are hoping that this road will be extended to serve their lands this fall.

After completing a small survey in tp. 21-11-6, the party moved to the centre of sec. 26, tp. 21-12-6, and on September 30 started surveys from the northeast corner of section 34. The northeast, northwest, and southeast quarters of section 35 are in timber berths, where logging operations have been carried on to some extent. There has been considerable merchantable timber on these lands and as logging has been done in strips and patches where the best of the timber stood, only a detailed cruise would determine the quantity remaining.

A saw-mill, located on Chum creek, near the southwest corner of the northwest quarter of section 35, is operated by steam power, is quite modern, and is capable of producing from ten to twenty thousand feet board measure per day. There is plenty of timber available to keep it in operation for several years.

The next work was in tp. 22-12-6, where a traverse of Adams river through sections 26 and 27 was made. This stream is used by the Adams River Lumber company as a means of bringing down their logs from Adams lake, and for this purpose a dam has been erected at the outlet of the lake; when the logs are being driven, the sluice gates are opened and a large quantity of water freed, carrying with it the logs that are to be driven. This volume of water in its course to Shuswap lake does considerable cutting to the banks of the river on which the traverse was made, and a very marked change is shown in the course of the river from that on the present township plan. This survey completed the season's work on November 3.

The weather conditions during the season were on the whole very favourable for carrying on survey work, the principal part of which was the delimitation of the boundaries of the forest reserves and in most cases these lines are to be found on the slopes of mountains.

APPENDIX No. 8.

STADIA SURVEYS.

Surveys by G. A. Bennett, D.L.S., in the Saskatoon District.

The investigation of all water areas in the block of townships in the vicinity of Saskatoon was carried on by Mr. Bennett. All lakes over five acres in area and rivers over one chain in width were surveyed so as to obtain accurately the area of the lands, which should be patented. Whenever the complete or partial drying up of a lake permitted the erection of a monument at a section or quarter-section corner, this work was done, provided it did not unduly delay the progress of the survey. A careful examination was also made of the condition of the monuments left by the original survey. Every month a report was forwarded to the department giving this information in detail for each township and stating the progress of settlement found, the amount of land cultivated, the number of road allowances graded, and all other information which would be useful in preparing a new plan of the township.

Survey operations were begun on May 19 in tp. 34-8-3, and the various townships in the vicinity were investigated. A number of small alkaline lakes were surveyed, but numerous lakes and sloughs which existed at the time of the original survey were found to have dried up. These townships are in the Goose Lake district. Most of the land is cropped and the road allowances graded.

As the surveys were continued north and west towards South Saskatchewan river, the country became more hilly and considerable bluffs of poplar and willow were found. Grain farming gave place to mixed farming on smaller holdings. Dairying has become an important industry, large quantities of cream being shipped into Saskatoon daily via the Canadian Pacific and Grand Trunk Pacific railways. In tp. 37-9-3 a large flock of sheep were noticed, but sheep raising is made difficult by the numerous coyotes or prairie wolves. In the rougher hilly country several large herds of young cattle were found in the care of homesteaders. These cattle were owned by grain farmers dwelling on the plains who paid the settlers in the hills to take care of and graze their stock during the summer months. This arrangement has proven so satisfactory that there has been a very considerable increase in the number of cattle raised in this part of the province during the last few years.

Lakes were found to be numerous in this district, fifty-five being discovered and surveyed in tp. 38-13-3. The lakes investigated in the hills contained fresh water from five to forty feet deep and appeared to have very permanent well-defined banks. At the foot of the hills large alkaline lakes were found. A lake in townships 36 and 37, range 12 has its source in several small creeks flowing out of the hills which compose part of the Keppell Forest reserve. It has no visible outlet and the water is a saturated solution of the various alkaline salts never more than twelve inches in depth. These salts crystallize out in a white efflorescence upon the lake shore during the dry summer months, and the peculiar odor then given forth has caused the lake to be known by the settlers throughout the district as Stinking lake. Considerable difficulty was experienced in surveying the twelve islands found in this lake. The water was not

deep enough to float a boat and the deep treacherous alkaline mud made it impossible to wade. However by using long poles and the canvas boat the islands were visited very probably for the first time by man during the summer months. Quantities of Saskatoon berries were found on the islands although very few were found elsewhere in the district, showing that the soil was fertile but causeways will have to be built out to the islands from the mainland before their agricultural value can be utilized.

On August 17 the traverse of South Saskatchewan river was begun in township 31, range 7. This survey was continued northeasterly to township 37, range 4. Very considerable changes were found to have taken place in the river channel during the thirty or more years since most of it was last surveyed. Large islands which formerly existed have entirely disappeared and in many places the river has shifted its channel, destroying the monuments placed near its bank by the original survey. The valley of South Saskatchewan river varies in width from one-half mile to four miles, with the river channel winding from valley bank to valley bank. Much of the river flat is now under cultivation so that the ever changing of the channel of the river is very destructive. As the river is most active in tearing away its banks during extremely high water it is probable that the reforestation of the upper watershed along the Rocky mountains and the taking out of water for the irrigation projects will tend to lessen the present rapid movements of the river. A few fish are found in the river, goldeye being the chief edible variety. Numerous signs of bank beaver were noticed as well as the tracks of a few jumping deer.

On October 5 the party crossed the South Saskatchewan on the traffic bridge at Saskatoon and proceeded to investigate townships east of the river. As the operations were continued southward many lakes were found in the vicinity of the town of Dundurn. The crops in this district were fair but more rust was noticed than on the other side of the river. This district has long been settled and the farmers possess fine houses and barns.

The weather throughout the season was not favourable for survey work. It was unusually rainy during the spring and summer and on October 3 three inches of snow fell. This remained only one day but on October 17 a twenty-four hour blizzard occurred which left from ten to twelve inches of snow. A week later this had melted but the roads were almost impassable. On November 7 the weather turned cold and the lakes and roads froze up. This weather made the threshing of the grain crops very difficult so that considerable grain was still in the stooks when the party was paid off in November 19.

Surveys by E. P. Bowman, D.L.S., in the Battleford District.

The work on which Mr. Bowman was engaged consisted of stadia traverses of lakes over five acres in area, and rivers over one chain in width, the investigation of marshes, sloughs and dried-up lakes, and the extension of the subdivision where possible across the dried-up water areas.

In the area comprised of townships 46 to 50 in ranges 15 to 18 west of the Third meridian the principal lakes are Jackfish lake in townships 47 and 48, range 17, and Murray lake in townships 46 and 47, range 16. Both these lakes are quite deep and have well-defined banks along the greater part of their shores. Very little change has taken place in their outline since the original survey. Generally speaking, the other lakes originally traversed in this block of townships have not changed much, except in townships 46 and 47, range 19, where a number of the old lakes have dried up. The water in many of the lakes in ranges 16 and 15 is fresh, while that in the lakes in ranges 17 and 18 is mostly alkaline.

There are no navigable streams in these townships. Turtlelake river is from twenty-five to fifty feet wide and from two to five feet in depth, with a rather slow current. Of the other streams the more important are Losthorse creek, Jackfish creek

and the creek through townships 46, ranges 15 and 16, emptying into Murray lake. Each of these is from ten to fifteen feet wide and from six inches to three feet deep. Losthorse creek flows through a deep valley, has a current of two to three miles per hour, and might be utilized for small power purposes.

The surface of the country is rolling, varying from gently rolling in some parts to hilly in others, and is partly covered with numerous clumps of poplar and willow. A number of the townships, particularly the more northerly ones, are mostly covered with poplar, willow and scrub, while in many parts fairly large areas of thickly timbered country are found.

These townships are fairly well settled with the exception of railway and other company land which comprises over half the area. Practically all available homestead lands of any value have been taken up, and some of the company lands closer to the railway. In many places, homesteaders, who have secured their patents, have left their lands, particularly in those districts more remote from the railroads. Townships 47 and 48, range 15, townships 47 and 48, range 16, and township 49, range 17 are not well settled as the country is hilly and stony in places and not suited for agriculture.

Mixed farming is the main industry of the settlers in this block of townships and yields fair success but ranching on a small scale is carried on by some. Grain growing is carried on more extensively close to the railroads and in a lesser degree, in the more remote townships. The distance of the northerly and easterly townships in this group from the railroads makes the marketing of grain on a large scale unprofitable and retards the bringing of all the available lands under cultivation. The soil is well adapted for the growth of all grains and vegetables, but wheat and oats are the principal crops grown and the yield is usually good.

Winter fishing is carried on in Jackfish and Murray lakes, the principal kind caught being jackfish.

The traverse of the lakes in this group of townships being completed on August 17, the party then crossed North Saskatchewan river at Bresaylor ferry and continued work in the area south of the river including townships 46, ranges 18 to 22, townships 47, ranges 20 to 23 and townships 48, ranges 21 and 22.

Several well-defined lakes were found in these townships which have not changed since the original survey. In general, however, the original surveys were made from thirty to thirty-five years ago and many of the lakes traversed at that time have partially or completely dried up. Several large permanent lakes, overlooked in the first surveys were found and traversed. A few of the more permanent smaller bodies of water, not previously surveyed, were also traversed.

Battle river flows through the southerly part of township 46, range 22. This stream is from one and one-half to three chains in width and has a current of two to three miles per hour. The valley banks rise 150 to 250 feet within forty chains of the river, and the slopes of the valley are mostly covered with clumps of poplar and willow. North Saskatchewan river flowing along the northerly limit of this block of townships, is the only stream of consequence.

The surface of this district is gently rolling or undulating and partly covered with numerous clumps of poplar and willow. The soil is for the most part a sandy loam or a clay loam with a clay subsoil and is well adapted for grain growing; in a few places it is very sandy and is unfit for agriculture.

Settlement is fairly good except on the company lands, and several road allowances are graded. Mixed farming, ranching and grain growing are the principal industries.

The Canadian Northern railway from Edmonton to Winnipeg runs in an easterly and westerly direction, across this group of townships. The main towns along this line are Delmas, Bresaylor, Paynton and Maidstone, all of which are small, and fairly prosperous, although much of their old trade has been cut off by the Turtleford

branch of the Canadian Northern railway to the north and by other railway lines to the south.

The next area examined comprises the following townships or parts of townships north of Saskatchewan river; townships 47, 48, 50, and 51, range 20, townships 48, 49, and 50, range 21, and townships 50, ranges 22 and 23. The lakes in these townships have, in most cases, dried up somewhat since the time of the original survey, although some of them remain unchanged. A number of small lakes which had not previously been surveyed were traversed. Turtlelake river and Englishman river are the main streams in this group, the former being from twenty-five feet to fifty feet wide and the latter from fifteen to twenty-five feet.

The branch of the Canadian Northern railway from North Battleford to Turtleford runs through the northeast corner of this group and affords fairly good transportation facilities. The principal business towns for the settlers in this group are Vawn, Edam, Mervin and Turtleford, all being small, thriving towns along the railroad. Turtleford, especially, is doing a thriving business at present, due to its being at the end of steel and drawing trade from a large territory to the north.

The surface is rolling with many clumps of poplar and willow, and in some parts there is a fairly heavy growth of poplar and bush with very little open country. The soil is mostly a sandy or clay loam with clay subsoil and is well suited for grain growing. Mixed farming is the main industry of the settlers. Grain growing for market is carried on by many, though few carry on this branch of farming exclusively. The percentage of land under cultivation in these townships varies from one-twentieth in some townships to two-thirds in others, the average percentage probably being about one-fifth. The climate is suitable for grain growing though in some seasons frosts are experienced before the crops are cut.

The last area examined comprises the following townships and parts of townships south of North Saskatchewan river; townships 50, ranges 24, 23, and 22; townships 49, ranges 22 and 23; and township 48, range 23.

Most of the lakes originally surveyed in this group have receded to some extent, some of them having dried up entirely. A number of new lakes were also surveyed. Big Gully creek is the main stream in these townships and is from ten to thirty feet wide. It flows through a fairly wide valley, the slopes being gradual.

The surface of the country is rolling to hilly with numerous clumps of poplar and willow. The soil is a sandy or clay loam with clay subsoil. Water can usually be obtained by digging to a depth of from twenty to fifty feet. Fuel is plentiful and easily accessible in the numerous bluffs, and building timber may also be obtained without much difficulty.

This work was completed on November 18 and the party began the traverse of North Saskatchewan river through a number of townships beginning at the north outline of township 50, range 23, and working southeasterly to the south outline of township 46, range 18. This work which completed the season's surveys was done on the ice, as it was found impossible to make reasonable progress during the summer.

The North Saskatchewan is from one-quarter to three-quarters of a mile in width becoming wider towards the east. There are numerous islands and many sandbars along the course of the river, thirty-nine islands being traversed in one township. These islands are mostly covered with balm of Gilead up to two feet in diameter and with a dense growth of brush. Much timber for building and other purposes is obtained on these islands by the settlers during the winter months. Some of the islands, however, are covered with only low willow brush. The banks of the valley rise fairly rapidly in places and more gradually in others and reach a height of from 150 feet to 300 feet within twenty to forty chains of the edge of the river bed. In places the slopes of the valley banks are covered with a dense growth of brush and timber, while in other places the slopes are mostly open with clumps of poplar and willow. The timber along the river valley is mostly poplar, balm of Gilead, birch, ash and spruce. Much of the larger timber has been utilized by the settlers for building

purposes. Many springs and small streams enter the river along its course, the main streams being Englishman river, Turtlelake river, and Big Gully creek.

Ferries for crossing the river are located in township 51, range 24; near the northeast corner of township 47, range 21; in township 46, range 19; and near Delmas in township 46, range 18. Very little teaming of grain across the river is done now as railroads are located on both sides. The trails or grades up the steep banks from the ferries are always very difficult for heavy loads, and in wet weather they are almost impassable.

Surveys by W. J. Boulton, D.L.S., southeast of Calgary.

The investigation of water areas carried on by Mr. Boulton extended over the district comprising townships 15 to 19, from range 13 to range 30 inclusive, west of the Fourth meridian.

The work in the early part of the season was considerably impeded by a prolonged spell of bad weather, rain falling almost every day until June 6. From June 8 till August 4, the party investigated and surveyed a large number of small water areas in that part of the district lying west of Bow river, exclusive of the township through which Little Bow river and Mosquito creek flow. Generally speaking, that part of the district west of range 22 is practically all settled and seventy-five per cent is cultivated and fenced. The old trails have completely disappeared and their places are taken in many instances by graded roads along the regular road allowances. During the past two years these townships have produced phenomenal crops, due principally to the great amount of rainfall. This particular district is decidedly prosperous looking as evidenced by fine barns, granaries and substantial dwellings.

The district to the east of range 22 bounded by Bow river is sparsely settled in its northerly half, a great portion of it being used for grazing. The southerly half, however, is partly settled and wheat is being grown to a considerable extent. This district now enjoys the facilities of fairly good railway transportation, the Canadian Pacific railway operating three accommodation trains weekly, and in the fall extra freight trains to take care of the grain.

Lake McGregor shown on the plans as being in townships 15, 16, 17, and 18, range 20, is not a reality as yet. This is a proposed reservoir for the Southern Alberta Land company's irrigation project. The retaining dams and a number of canals have already been constructed, but further work has been temporarily suspended.

The investigation of the district to the east of Bow river was commenced on August 4. This district is practically unsettled and is owned by the Canadian Pacific Railway company which has spent a large amount of money in the construction of aqueducts, siphons, canals, and laterals for irrigation purposes. A large reservoir called Newell lake, has been created in the valley along the range line between ranges 14 and 15, and which occupies parts of townships 16, 17, and 18. Not more than seven per cent of this irrigation district is under cultivation. The soil is of a light sandy variety, but if properly irrigated should be very productive. Scattered throughout this district are many small sloughs, which in dry seasons would probably contain no water; a few alkaline mud flats were traversed.

Bow river was next traversed through tps. 17, 18, and 19-18-4; tp. 17-17-4; and tps. 15, 16, and 17-16-4. Ferries have been established and are operated by the Provincial Government at intervals of twelve or fifteen miles. A splendid coal mine is in operation at "Bow City," but its activities and output are hampered by lack of railway transportation.

The traverse of Little Bow river was commenced on the S. by. tp. 15-21-4, and continued up stream through tps. 14 and 15-22-4, and tp. 15-25-4. Mosquito creek was also traversed from its mouth in tp. 15-25-4 to the point where it crosses the E. by. tp. 16-29-4.

The investigations of the townships in the southwest corner of the district completed the season's work.

SESSIONAL PAPER No. 25b

Surveys by G. C. Cowper, D.L.S., in the Sounding Creek District, Alberta.

On May 20 Mr. Cowper began work in tp. 24-13-4. The season's surveys consisted of traverse by stadia of all water areas over five acres and the establishing of monuments on the dried-up beds of lakes and marshes.

With the exception of a few boundary townships, the surveys were confined to that block of townships extending from township 22 to township 33, and from range 4 to range 13 inclusive, west of the Fourth meridian. These townships lie immediately north of Red Deer river and are all prairie. The only wood found grows along the river. The townships adjacent to the river are more or less highly rolling, and continue rolling as far north as township 29. North of this township the surface is either level or gently rolling.

The soil is mostly a sandy loam, although in some of the townships considerable gumbo and alkali was encountered. On the whole this district is excellent for farming as the soil with sufficient moisture is very productive, and all grains and roots do very well. Except in the townships along the Red Deer, water is readily obtained at a depth of fifteen to fifty feet and is mostly of good quality. This block of townships is very well settled, there being practically no homesteads available.

The Saskatoon-Calgary branch of the Canadian Northern railway enters this block in township 28, range 4, and leaves it in township 31, range 13.

During the summer of 1916 the Canadian Northern Railway company commenced construction on their branch line from Hanna to Steveville. This line leaves the Saskatoon-Calgary branch in township 31, range 13, and crosses Red Deer river at Steveville in township 22, range 12; eventually it will be extended to Medicine Hat. This branch will provide convenient railroad facilities to a large number of settlers, but the district will not be sufficiently served by railroads until a line is built parallel to the Canadian Northern and midway between it and Red Deer river. The settlers immediately north of the river haul their grain south to the Empress-Bassano branch of the Canadian Pacific railway, but on account of the steep grades to the river they have considerable trouble.

As coal is the only fuel used, the settlers are fortunate in being able to obtain it in townships 29, ranges 12 and 13, and also in township 32, range 13. This coal occurs in seams several feet thick and at a depth of five to fifteen feet. The largest of the mines operating is at Sherness in township 29, range 12. Before the Canadian Northern railway was constructed the settlers for a hundred miles east came there for coal; it is of fairly good quality, although it soon disintegrates on exposure to the air.

As the lakes and sloughs in this district fill almost entirely from the drainage of the surrounding country, and evaporation is their only outlet, their condition depends wholly upon the rainfall. In a dry year, such as 1914, all the lakes are dry, while in a wet season, such as last year, they are all full of water.

In all the townships investigated a large amount of surface water was encountered almost every section containing some water. By far the greater number of these water areas were only flooded hay marshes, and in a normal year hay would be cut on them. Last season they were covered by a foot or two of water which prevented hay from being cut.

Comparatively few lakes were encountered during the season. In ninety-two townships investigated only eighty-seven lakes were found which appeared to be of sufficient permanency to warrant the traversing of them. With the exception of one or two, all of these lakes were reported to be dry in 1914, but the majority are only dry in very dry years, and when they are dry their beds are of practically no value.

No important lakes were traversed, Kirkpatrick lake in township 33, range 9 and townships 33 and 34, range 10, being the largest one. Although this lake was completely dry in 1914, during the past season it was five miles long, two miles wide and

seven feet deep in the centre. At the west end it runs out into a large hay marsh. Antelope lake in township 31, range 9, although only two and a half miles long and a mile and a quarter wide was the next largest. Sounding creek enters at the north and drains out of it at the south. Dirty lake in township 25, range 9, might be mentioned as an example of a lake which dried up in 1910 and remained dry until the fall of 1914. Although it produced a good crop of hay in 1914, last June it was covered by six feet of water. The majority of the lakes traversed were alkaline, but only a few were too strongly alkaline to prevent stock from drinking the water.

On September 21 the traverse of Red Deer river was commenced in township 22, range 12. This river was traversed east as far as the north boundary of township 22, range 4, with the exception of township 21, range 10 and townships 23, ranges 7 and 8 which had been previously traversed. In this stretch the width varied from six chains to thirty chains, with an average width of about ten chains. The river is full of islands and sandbars. In ten townships, seventy-eight islands varying in size from a fraction of an acre to two miles long and twenty chains wide were traversed. The main channel of the river is only a few chains wide and at low water is about five feet deep with a current of about four miles an hour. On account of the many shifting sandbars it is unlikely that the river will ever be navigated to any extent. In many places the shore of the river is a steep cut bank ten feet high and then a level flat of a few chains covered with dense brush and thorn bushes. There is also a considerable amount of poplar, balm of Gilead, and black birch along the river valley and on the islands.

A large number of beaver were noticed on the river, and they seem to be increasing rapidly. The only other game noticed during the summer were numerous ducks and a few chickens. No antelope were seen although their tracks and also tracks of deer were noticed along the river. The past season was exceptionally wet and considerable time was lost on that account. A heavy frost occurred on August 11.

Surveys by T. A. Davies, D.L.S., in the Wainwright District.

The block of townships in which Mr. Davies was employed, extends from township 38 to township 47, range 1 to range 9, west of the Fourth meridian, together with tp. 37-4-4 and tp. 37-28-3.

Work was begun on May 16 and continued until October 7. The surveys required were then completed, except for the traverse of Battle river which was postponed until the ice should form, as the survey could then be carried out more expeditiously.

Weather conditions throughout the season were not favourable, the rainfall being heavy. The surface of the country generally is rolling. Through ranges 5 to 9 there are clumps of poplar and willow scrub but ranges 1 to 4 are practically all prairie. The lakes are comparatively small and generally alkaline. Killarney lake in townships 41 and 42, range 1 and Sounding lake in township 37, range 4 are the two largest bodies of water.

Transportation facilities are good, as the district is crossed by the Canadian Pacific railway in the southern part and the Grand Trunk Pacific in the northern part. Roads through the most of these townships are graded where most necessary, and bridges are built across the more important creeks.

The production of grain is the chief industry of the district, wheat being the principal cereal. Oats, barley, and an occasional field of flax are of secondary importance. Potatoes and other vegetables are grown, mostly for private consumption. A few settlers through these townships give their attention entirely to cattle raising, but mixed farming is becoming more popular.

The most advanced settlement and best farming district is in the vicinity of Cairns, Cadogan and Prevost along the Canadian Pacific railway, especially in the

country about Prevost, where almost all the land is under cultivation and is producing large crops of grain.

On October 7 the party was paid off and the outfit stored in the vicinity of Wainwright, Alberta.

Surveys by J. H. McKnight, D.L.S., southeast of Prince Albert.

The season's surveys were begun by Mr. McKnight in tps. 39 and 40-19-2. These townships contain numerous shallow lakes with abundant hay around the edges. The surface is covered with poplar and willow scrub, but the soil is good and is especially adapted for mixed farming.

In township 41 range 19 and township 42 range 20 the surface is high and rolling, with considerable bush. The lakes nearly all contain fresh water and a depth of ten feet was found in a lake in township 41 range 19. This lake is a mile and a half long, three-quarters of a mile wide and is fed by springs. In township 43 range 19, there are several large lakes, the water being slightly alkaline and averaging nine feet in depth.

The block comprising townships 44 and 45 ranges 18, 19 and 20 is open and well settled and the roads are good. Many large grain fields were noticed and there has not been a crop failure during the past fifteen years. Several herds of cattle were also seen. The farmers are very prosperous and nearly all have telephone connection with Melfort. This town is situated on the Canadian Northern railway and has a population of about 1,400. It is very prosperous and has electric lighting, water-works and sewerage systems. There is also a large government creamery in the town, with an average weekly output of 12,000 pounds of butter. There are a few shallow lakes and the district is well drained by Melfort and Goosehunting creeks, which empty into Carrot river.

In the district around Kinistino which was next investigated the surface is undulating, with poplar bluffs and is fairly well settled. The farmers have nearly all gone in for farming or stock raising, with success and several large herds of cattle were noticed. This district is drained by Carrot river, which is the outlet of Waterhen lake. This lake is six miles long, two miles wide, contains alkaline water, and is about five feet deep. In township 44 range 21, there is a large lake locally known as Waterhen marsh. It is about five miles long, one mile wide and is full of rushes. The water is alkaline and the outlet of this marsh is also Carrot river. The soil of Carrot river valley is noted for its fertility.

Ducks were very plentiful in the whole district, but no large game was seen. Deer are, however, reported to be plentiful in township 42 range 19.

Surveys by P. E. Palmer, D.L.S., in the Outlook District, Saskatchewan.

The area covered by Mr. Palmer's surveys extends, in a general way, from township 18 to township 30, across ranges 2 to 17 west of the Third meridian. The party was organized at Saskatoon on May 16 and from that date until July 5 the townships east of South Saskatchewan river were examined. This district is generally very dry, and very little traverse work was necessary. The party however was kept fairly busy with resurvey work such as erecting monuments at corners which were wet at the time of the original survey. About July 1 several very heavy rainfalls occurred which filled up most of the marshes and from that time on very little resurvey was possible. The area comprised in this block is for the most part excellent farming land and well settled. The roads are usually good and nearly every farmhouse is reached by the rural telephone lines. It appears to be a very prosperous section of the country.

On July 5 South Saskatchewan river was crossed at Elbow and from there work proceeeded west through townships 23 to 27 as far as range 13. In townships 24 and 25 ranges 10 and 11 and in township 22, range 13 a good deal of traverse work was necessary, but elsewhere in this district there was very little of either traverse or resurvey to be done. On account of the Coteau hills which run through this section there are no large continuous areas of agricultural land, but on the flats between the hills and the river and especially in townships 22 and 23 ranges 8 and 9 there is some exceptionally fine land. All this district west and north of the South Saskatchewan has been greatly handicapped by the lack of railway facilities. In some cases settlers have had to haul their produce forty or fifty miles over a rough country, in addition to crossing the river, in order to reach a market. This condition is now being remedied as the Canadian Northern railway has a line under construction which will serve the needs of a large part of this area. Some large grazing leases are still found in this district, the Matador ranch which embraces nearly six townships being the most important. This ranch usually has between five and six thousand catttle. About one-third of this lease is very good farming land but the rest of it could be used for nothing but grazing.

On September 5, the South Saskatchewan was again crossed at Saskatchewan Landing and a traverse of Swift Current creek was made in townships 19 and 20, range 13 and of South Saskatchewan river in township 20, range 13. On September 13 the party started down the river by scow, traversing both sides of the river and the islands, on the way.

Difficulty was often experienced in finding old monuments near the river on which to tie the traverse. In some cases it was necessary to go back two miles or more from the river to make a tie. The scow proved to be a very convenient method of moving on this work as many long detours would have to be made around ravines in moving with horses and wagons.

On October 30, the traverse of South Saskatchewan river in tp. 30-8-3 was completed and survey operations were closed for the season.

Surveys by C. Rinfret, D.L.S., in the vicinity of Moosejaw.

Mr. Rinfret began work south of Moosejaw in tps. 13 to 17-25-2; tps. 14 to 16-26-2; tps. 15 and 16-27-2; and tp. 16-28-2. The surface of these townships is undulating to gently rolling and the soil consists of a good clay loam. There are very few permanent bodies of water except Moosejaw creek.

All of tps. 10 to 13-26-2, tp. 11-27-2; and tp. 15-28-2 are highly rolling to hilly open prairie. Although very good crops are raised in a few level spots the land is best suited to ranching purposes. There is abundant grass and hay, fresh water, and proximity of railroads.

Townships 7 to 11, ranges 1 to 7, townships 12, ranges 2 to 7 and townships 13 and 14 ranges 3 to 7 all west of the Third meridian were then investigated. These townships form what is generally called the Gravelbourg district through which the Canadian Pacific and the Canadian Northern railways run. The surface is rolling and the soil is of first-class clay loam. Although this district began to be settled only ten years ago a good percentage of the land is now under cultivation. The best fields of grain noticed during the whole season were found to be around Gravelbourg. Water is scarce in some places but Wood river, Notukeu and Wiwa creeks furnish a good supply of excellent water.

The northern part of this district composed of townships 13 and 14, ranges 3 to 7, is more highly rolling and contains some alkaline ponds and flats. The fact that its distance from the railroads is some twenty to thirty miles renders it less desirable to settlers. There are however some prosperous farmers.

The last work was in townships 8 to 11, ranges 28 to 30, west of the Second meridian, adjoining lake of the Rivers. The surface in these townships is rolling except in the immediate vicinity of the lake where it is broken by ravines. The soil is good and well adapted to grain growing. There is room in this district for many more farmers who would make a good living. A branch of the Canadian Pacific railway is being built about ten miles west of the lake.

In the district covered during the past season, the crop was fairly good. Some fields suffered much from the rust but where the soil had been summer fallowed and the seeds well selected splendid crops were noticed. Experienced farmers stated that they had not had a failure for the last ten years. Although there was more snow and rain last year than for many years past, many lakes were found to have dried up since the country was subdivided. Forty-three section corners then under water are now dry and were marked by proper monuments.

Surveys by W. A. Scott, D.L.S., North of Regina.

Mr. Scott's work consisted of the investigation and necessary traverses of water areas in the block of townships situated approximately between the main lines of the Grand Trunk Pacific railway and the Canadian Pacific railway between ranges 15 and 22, west of the Second meridian. Bodies of water recorded by previous surveys were examined and a careful exploration of the country made for any other lakes which might exist. In addition to this monuments were erected at section and quarter-section corners which were formerly covered by water. Many depressions which seldom contain water were flooded, due principally to the heavy snowfall of the past winter and also to an unusually wet summer, and the ordinary sloughs and lakes were at high-water mark. This condition made it difficult to determine what bodies of water were permanent.

Two-thirds of the country investigated was prairie and the remainder varied from poplar bluffs bordering on the prairie to bush country in the Touchwood hills. Practically all of the land is patented, but much of it over five miles from a railway is vacant, being held by large land companies or individual speculators. In general the prairie lands may be said to be occupied by Canadian, English, or American farmers, the bluff country by Germans, chiefly from the United States, and the bush country by Germans, Austrians, Hungarians, Russians, and Galicians who have recently immigrated.

In the prairie country the land is devoted almost entirely to the growing of grain. Good roads are constructed at a comparatively small expense, and most of the roads allowances are graded. Much work has been done in recent years and it would appear from the progress made that it will be only a short time until there are good roads everywhere. Telephone lines exist almost everywhere up to five and ten miles from the towns, and the lines are being rapidly extended to cover greater areas. Water on the prairie is scarce and the farmer is fortunate whose land contains a drainage channel which can be dammed to store water for the summer months.

In the country containing bluffs, one-half of the roads are graded and these only where necessary, but the main avenues of traffic are well graded and kept in very good condition. Water supply is not such a problem, for only in an exceptionally dry season do all of the sloughs dry up. The land in this area is devoted chiefly to mixed farming.

The greater part of the bush country has been settled by Europeans with no capital, and progress has necessarily been slow, but in spite of this, there are a few well-graded roads, and close to the towns there are telephone lines. The settlers have confined themselves chiefly to raising cattle, but as more land is cleared mixed farming will be carried on.

There is some game in the district investigated, chiefly ducks, prairie-chickens, rabbits, and muskrats. Partridges seem to have almost disappeared. There are still a few deer in the Touchwood hills.

Surveys by H. M. R. Soars, D.L.S., in the vicinity of Wetaskiwin.

The season's surveys on which Mr. Soars was employed were begun in tp. 46-23-4 near the village of Gwynne. This village is the centre of a busy dairying country, much milk and cream being shipped over the Canadian Pacific railway to Edmonton and Camrose. The settlement contains a mixed population, the majority being Scandinavians.

Until 1914 a brick-kiln was operated at Gwynne and turned out a very fair sample of brick but it had to close down owing to the cessation of building in Wetaskiwin and Camrose. The area between these two towns, comprising townships 45, 46 and 47, ranges 20 to 23, is well adapted to mixed farming; it is drained by Battle river and tributary creeks, the largest of these being Pipestone creek.

There are three fairly large bodies of water in these townships. Driedmeat lake, Coal lake, and Bittern lake; the two former are of very similar character, lying in valleys from sixty to one hundred feet deep, the banks of which are well wooded. The former lake is drained by Battle river the latter by its main tributary Pipestone creek. Bittern lake in townships 46 and 47 ranges 21 and 22 is a surface-fed alkaline lake. It has no outlet but could easily be drained into Battle river, which lies about 175 feet lower than the lake and distant about one and a half miles. Lakes and sloughs are very numerous in tp. 45-22-4, some of them containing fairly good water, but the majority of water areas in this locality are distinctly alkaline.

Battle river which was traversed through townships 45, ranges 22 and 23 and townships 46, ranges 20, 21 and 22 has an exceedingly tortuous course; six steel traffic bridges cross it in this district. It flows in a valley which averages three-quarters of a mile in width and from sixty to one hundred feet in depth. It is about five feet deep and the water is excellent, the current being fairly swift and running over a gravelly bed. The valley bottom is generally covered with dense willow but where these have been cleared good hay land has resulted; this year the river flooded these flats in September and considerable hay was spoiled in the stacks.

A small outcrop of soft coal was noticed in sec. 6, tp. 46-22-4.

From these townships the party worked north and east the land being more open and level. The water areas are surface fed and decidedly alkaline, and the bush somewhat lighter; some of the wells were found to contain water strongly impregnated with salt; this was particularly noticeable in sec. 3, tp. 47-19-4.

Soft coal mines are in operation in sec. 17 tp. 48-19-4; sec. 30 tp. 49-19-4 and sec. 7 tp. 46-18-4.

The country around Bawlf and Daysland in townships 45 ranges 15 to 18 was found to be so badly flooded that many of the crops were lost and work had to be discontinued. If Driedmeat creek, which drains this section of land, were cleaned out and deepened in places it is probable that the surrounding country would benefit considerably. At present the roads after any heavy rain are in a deplorable condition and much of the land is under water.

These townships are very suitable for mixed farming as the markets are easy of access and there is sufficient bush to afford good cattle shelter. The majority of the settlers appeared prosperous and well supplied with horses, cattle, sheep, hogs and machinery.

Some severe hailstorms were experienced in the fall especially in townships 49 ranges 18 and 19, and owing to the late spring nearly all the wheat and barley was caught by early frosts.

Work was discontinued from October 25 to January 8 when the traverse of Battle river and such lakes as could not be surveyed in the summer was made. This work was completed on February 19.

SESSIONAL PAPER No. 25b

SURVEYS BY C. M. WALKER, D.L.S., IN THE HUMBOLDT DISTRICT.

Before proceeding with the regular stadia surveys Mr. Walker was employed for about ten days, on the completion of the survey of Block 40 of the St. Julien addition to the townsite of Banff which had been left unfinished the previous season.

The regular stadia surveys were commenced in tp. 43-27-2, and included the work in townships south and west of Humboldt.

In the northerly portion from township 39 to township 44 the surface is very rough and covered with a dense growth of bush which made progress slow. Every section had to be investigated as the settlers were nearly all from central Europe and could not speak English well enough to tell where the water areas were. Graded roads were very scarce and it was difficult to get from place to place. The shores of some of the lakes were very boggy and horses could not be taken near without getting mired. In nearly every lake and slough the water was so alkaline as to be unfit for stock.

Farther south around Buffer lake the surface of the country is level, especially to the east, where many sections are so wet as to be useless for agriculture. The lake is very shallow and the water strongly alkaline.

The party proceeded south through ranges 28 and 29 as far as township 34 and thence worked easterly.

The country in the neighbourhood of Colonsay and Viscount is in a very prosperous condition, graded roads, telephone lines and rural mail deliveries being almost everywhere. Several farmers with large holdings have taken up properties, have erected splendid buildings, and made many improvements. In fact this would appear to be as fine an agricultural district as any in the West. One farm alone in the vicinity of Viscount is comprised of fifteen sections of land, and is worked by the most modern methods. It might be noted in passing that the total crop on this farm, with the exception of two hundred acres, was completely destroyed by a severe hailstorm, which passed over this district in August.

North of Viscount in townships 36, 37, and 38, ranges 25 and 26, the surface is very rolling and with numerous small sloughs and ponds; these sloughs are invariably alkaline, usually with a strong disagreeable odor. The soil is inclined to be gravelly. The settlers are mainly Austrians, Galicians, and Germans, and are of a very unprogressive nature, there being scarcely any local improvements in these townships.

The next work was the investigation of tp. 36-22-2, tp. 36-23-2, tp. 35-23-2 and tp. 47-1-3, in the order named. A large portion of tp. 47-1-3 is covered with thick bush and brush, and consequently the settlement, is in a somewhat backward state. The only graded road found adjoins the Third meridian. Quite a large portion of this township is suitable as hay land only. Large floating muskegs were found, in the western portion of the township, adjoining the Pines Forest reserve.

APPENDIX No. 9.

MISCELLANEOUS SURVEYS.

Resurveys by C. F. Aylsworth, D.L.S., in Manitoba.

The party of which Mr. Aylsworth had charge left Winnipeg on April 8 for tp. 18-19-Pr. to resurvey that portion of the township lying outside the forest reserve. The southwest corner of the township is heavily timbered but the eastern part is more open. Some of the homesteaders have been located there for about ten years and are in a very prosperous condition while the more recent arrivals are also doing well.

Completing this work on May 31, the party next moved to tp. 38-28-Pr. to subdivide the portion of the township not included in the forest reserve. The Canadian Northern railway runs through the township to the east. Bowsman in that township being the nearest railway station. The farmers in that vicinity appear well-to-do as the soil is rich and easy to cultivate. North of Bowsman where the district is hilly the rainfall is plentiful, a shower falling almost every day, but in the valley the precipitation is considerably less. West of Bowsman there is a heavily timbered area and the land will be difficult to clear, but the surface is undulating and easily drained and the soil is fertile. The forest growth consists of poplar and spruce with hazel underbrush, and the soil is good clay loam.

On completing this work on July 14 Mr. Aylsworth was forced to cease field operations on account of ill health. The work of the party however was continued under the management of Mr. J. A. S. King, D.L.S.

Subdivision and Resurveys by J. M. Cote, D.L.S., in Saskatchewan.

Mr. Cote's first work was a resurvey in tps. 41 and 42-23-2. These townships are badly broken up by lakes and sloughs, but the few settlers who have taken up land in the district are engaged exclusively in mixed farming and seem to do remarkably well. The northern portion of township 42 is thickly covered with bush, consisting mostly of poplar, some of which measures ten to tewelve inches in diameter. Roads are unknown in that part of the township and the rough route followed would have been impassable with loads, had the frost been out of the ground.

The eastern portion of tp. 47-1-3 was next resurveyed. This township lies outside the boundaries of the Pines Forest reserve. The soil is light and as a general rule crops are not good. The surface is well covered with bush and is broken up by numerous lakes, sloughs and muskegs

After completing this work the party resurveyed tp. 34-5-3 and tp. 34-6-3. The land in this district has all been taken up and the greater part of it is under cultivation. Crops are usually good but this year they were greatly damaged by hail. The southwest corner of tp. 34-5-3 is within the Dundurn Forest reserve. The surface is gently rolling, with numerous bluffs of poplar and willow bush. Beaver creek crosses the township from the southeast to the northwest. Last year a fair crop was raised but as a general rule, on account of the light soil, crops were poor. The surface of tp. 34-6-3 is broken up by the valley of South Saskatchewan river, which is from two to four miles wide. The survey of this township was made when the river was high and the greater part of the valley was under water. This, coupled with the heavy growth of willow, greatly delayed the progress of the work.

In order to move camp across the river it was necessary to go around by Saskatoon, a distance of over forty-five miles. Pike lake lies in the southwest of this township. This lake, which contains fresh water, presents many attractions and hundreds of people, principally from Saskatoon, visit this resort during the summer months. The Saskatoon Auto club has erected a club house on the shore of the lake and many are following its example by building summer cottages. The work in these two townships was completed on August 2.

Some small miscellaneous surveys were carried out in tps. 30, 31, and 32-28-2 and tp. 31-29-2..

In order to expedite the work the party was divided into two sub-parties to do several small scattered surveys. These two sub-parties united again in tp .50-25-3, after having made surveys in nineteen different township during the month.

The surface of tp. 50-25-3 is rolling to rough rolling. It is dotted with patches of poplar and willow bush and with numerous lakes and sloughs. The soil is a rich clay loam and crops are usually good.

When the resurvey of tp. 50-25-3 was completed the party was again divided into two sub-parties and small surveys were made in nineteen townships: tp. 31-12-2; tp. 41-13-2; tp. 37-14-2; tp 45-2-3: tp. 45-27-2; tp. 38-22-2; tp 38-23-2; tp. 39-18-2; tp. 39-15-2; tp. 27-10-2; tp. 26-10-2; tp. 26-9-2; tp. 41-23-2; tp. 45-27-2; tp. 36-17-2; tp. 46A-26-2; tp. 47-26-2; tp. 47-27-2 and tp. 46-12-2. Operations were then closed for the season on December 4.

Scattered Surveys by S. L. Evans, D.L.S., in Saskatchewan and Alberta.

The miscellaneous work performed by Mr. Evans consisted of the resurvey of townships in southern Saskatchewan, the examination of subdivision surveys northwest of Peace River, miscellaneous surveys northeast of Edmonton, the completion of the survey lines of timber berth No. 2,333, and retracement surveys in connection with Lac La Biche settlement. Field work was started with the resurvey of tp. 32-5-3, commenced on April 24 and completed on May 1.

From this township the party moved across country travelling through the Outlook, Rosetown, and Elrose districts. The lands in the two former districts are well taken up and are being farmed extensively. Fair crops were harvested last season, and fully fifty per cent of the land was under crop. These districts are counted among the choicest grain-growing parts of Saskatchewan. Branch lines of the Canadian Pacific and Canadian Northern railways serve the people with fairly good shipping facilities. The Elrose district has only been settled in the last few years, but already good progress is being made by the settlers. A new branch of the Canadian Northern railway has recently been extended to the west of the town and will give the farmers better shipping facilities.

The south two-thirds of tp. 20-16-3, tp. 22-18-3, and tp. 20-14-3 were next resurveyed This work was completed on July 20. South Saskatchewan river passes through these townships, and the lands in the valley are largely used for ranching purposes. Part of the bench lands in tp. 22-18-3 are only useful for grazing purposes, being composed of sand hills. The bench lands of tp. 20-16-3 are rolling prairie and are well settled; good progress is being made by the settlers. Township 20-18-3 is largely held for grazing lands, being part of the lease of the Matador ranch, one of the largest cattle ranches in the province. Settlers from this district are served either by the Canadian Northern railway (Elrose branch) or the Empress branch of the Canadian Pacific railway, located to the south of South Saskatchewan river. Success, Pennant, and Cabri, the adjacent towns on the latter railroad, are growing business centres. The town of Cabri for the year 1915 has the unique record of shipping the second largest amount of grain for any station in America.

The next work, the resurvey of tp. 12-17-3, was completed on August 10. Webb, on the main line of the Canadian Pacific railway, is the trading town for this district. It has a population of 400 and is a first class farmers' town. The lands in this district are very choice prairie, and are well settled and farmed. Most of the area is under tillage, and good crops have been harvested.

The lands in tps. 14 and 15-19-3 have only been taken up in the last five or six years but already considerable of the acreage is under crop. The surface is rolling prairie with good clay loam soil. Gull Lake is a prosperous business centre of 900 population. It might be noted that the first frost to occur in the Gull Lake district was on September 14, but no damage resulted to the crops as nearly all the grain had been cut. Throughout the season there was an abundance of rainfall; in fact, in many nearby localities there was too much moisture, and rust developed on the grain which lowered the crop yield considerably.

In connection with the resurvey of all of the above-mentioned townships, levels were run over a certain number of the surveyed lines, using the new style survey posts for bench-marks. These levels were connected by tie lines to known elevations on the Canadian Pacific railway and they can thus be reduced to elevations above sea-level.

On October 5 the examination was commenced of the subdivision surveys made by Mr. J. C. Baker, D.L.S., north of Peace River. The lands investigated are in the Battle River country and some excellent, fairly open farm land will be available when these townships are thrown open for homesteading. Some large areas of merchantable timber are found in the district. No railway lines operate on the north side of Peace river, but the Edmonton Dunvegan and British Columbia Railway company are building a steel bridge across the Peace at Peace River, and it is probable that in the course of a few years the north side of the river will be supplied with railway facilities which will give an impetus to the settlement of that vast country.

Several small miscellaneous surveys were made northeast of Edmonton, such as investigating dried-up water areas, the extension of subdivision lines across already reported dried-up water areas, and the building of mounds at corners where formerly in the original survey of the lands the monuments had not been built. These surveys were in tp. 60-18-4, tp. 59-11-4, tps. 59 and 61-12-4, tp. 57-10-4, tps. 57 and 58-9-4, tp. 60-6-4, and tp. 56-3-4.

Considerable of this territory is in the St. Paul de Metis district, and is fairly well settled but up to the present the settlers have had very poor railway facilities. St. Paul de Metis is a thriving town of 600 population and is located seventy-five miles from Vegreville, the nearest shipping point, on the Canadian Northern railway. The Oliver St. Paul branch is under construction and at the present time about fifty miles of road-bed is graded and just recently the laying of steel from the Oliver end of the road was begun. This road when completed will serve a very large territory. A great deal of the land is choice farming country covered with scrub and small poplar and should show rapid development once the settlers have the means of shipping out their grain.

When these surveys were completed on December 22, the boundaries of timber berth No. 2333, located in tp. 74-5-5 and tp. 74-6-5 were surveyed. A small retracement at Lac La Biche completed surveys for the season.

Scattered Surveys by L. E. Fontaine, D.L.S., in Alberta.

Field operations were begun on June 1, and until July 12, Mr. Fontaine was engaged on small surveys in the vicinity of Strathmore, Morley, the city limits of Calgary, Furman, Boundary Creek, and Turin.

Following this a preliminary survey was made for the projected subdivision of parts of sections 10 and 11 in township 29-20-4, adjoining the town of Drumheller; some small surveys were also made at Okotoks and Crossfield.

In the Edmonton district surveys in the vicinity of Carvel, Stonyplain, Hinton, Nordegg, Holborn, Glenister, Mosside, Maybridge, Bardo, New Sarepta, and Grammia were performed. The season's operations were closed on December 22.

During the season the operations covered a wide range, and for the most part were in well-settled sections, and in many of these the neat and comfortable appearance of school and farm buildings are evident signs of prosperity. The towns of Drumheller and Nordegg are industrial centres and will yearly grow in importance as both of them are headquarters of several important coal-mining companies.

The surveys were varied in their nature ranging from investigations to subdivisions and as in most cases the length of time required to complete any one of them was but a few days, help and transportation were procured locally.

Subdivision and resurveys, by J. A. S. King, D.L.S., in Manitoba.

After the resignation on account of illness of Mr. C. F. Aylsworth, D.L.S., his party was taken charge of by Mr. King, his assistant. From that date, July 15, 1917, till the end of the season the work consisted of subdivision in tps. 40 and 41-25-Pr.; miscellaneous work in tp. 43-26-Pr, tp. 44-27-Pr, tp. 44-28-Pr, and tp. 44-29-Pr, these being in the Porcupine mountains or the immediate vicinity; retracement, subdivision, and investigation at Big-grass marsh, with three and one-half miles of base line; the retracement and re-establishment of the boundaries of Moose Mountain Forest reserve; the traverse of Swan lake and river in tps. 40 and 41-23-Pr; the investigation of monuments and traverse of Woody river in tp. 40-24-Pr, the determination by chainage of the difference of latitude between the ends of the 8th base line in the first and second systems of survey; the investigation, retracement, and subdivision of Lizard lake in tp. 4-7-Pr. and tp. 4-8-Pr. near Manitou, Manitoba; and the retracement and subdivision of lands around Whitewater lake in tps. 3 and 4-21-Pr. and tps. 3 and 4-22-Pr. This work was completed on January 24, 1917.

Swan lake is a fine large body of water, particularly free from islands. Its southern and western shores are mostly low and marshy. Swan river enters it exactly at the north boundary of township 40, range 23. The river during its course in this township is very deep and sluggish, somewhat crooked and having cut clay banks which everywhere are heavily overhung with underbrush and trees, undermined and fallen over. The lands all around this lake are very flat and marshy and it seems very probable that the lowering of Swan lake by one or two feet would do a great deal towards making this one large hay marsh, suitable for hay cutting. At present large areas of it, while producing a luxuriant growth of hay, are far too wet to allow of the saving of the crop. Settlers say that Shoal river, the northern outlet of Swan lake, is very shallow and that a deepening of its channel would materially affect the drainage of this area. Swan lake and river is the end of the old Hudson's Bay company's route of bringing supplies from Hudson bay to the interior country. Here at some point in Swan river, according to the season and height of water, the freight was transferred from the York boats to the Red River carts. The old Hudson Bay-Fort Pelly trail, following Swan river, is still the one used into this country from the railroad.

The district included in townships 40, ranges 23 and 24 and township 39, range 24, is remarkably well adapted for hay cutting and grazing even at present, with its poor drainage, and during the present season ranchers have begun operations on an extensive scale.

A small settlement of French half-breeds has been in township 40, range 23, since 1871, they being old Hudson's Bay Company employees and their numerous descendants. This township lies in what is known as the Swan river valley or locally as the "Swan" district. It has been settled for about twenty years and is very prosperous. Its climate is on the whole milder than most of Manitoba, and blizzards are almost

unknown there. At Bowsman, strawberry culture has been made a paying proposition, a plot of five acres one year having been successfully raised and marketed at a good profit.

The work along the Canadian Northern railway in tp. 43-26-Pr. and tp. 44-27-Pr. consisted of small jobs along the Porcupine Forest reserve boundary and in heavily timbered country. The northeast corner of township 44, range 27, was on the flat land at the foot of the mountains and subject to floods. These floods do not run off very quickly owing to the very slight fall to the lakes and rivers.

In townships 44, ranges 28 and 29, a strip of land about ten miles long and from one to two miles wide and bordering on the Porcupine Forest reserve was subdivided. This is very heavily wooded, though most of it has been logged over, and consequently the bush is very dirty in places. A great deal of very fine spruce still remains to be cut in this vicinity, where timber berths have not yet been worked. Spruce up to forty inches in diameter was cut on the line. Very fine large birch grows in this region but at present is not cut for lumber. None of this land is at present in a state suitable for farming or even grazing but when this land is cleared the soil will likely prove exceedingly rich, owing to its rich mulch of forest waste and to the alluvium washed off the mountain sides. The Canadian Northern railway parallels this strip about a mile and a quarter to the north.

The Big-grass marsh was an area approximately seventeen miles long and three to four miles wide. Within the last four or five years it has been drained by the Provincial Government and is now nearly all dry except for a lake about three miles square near its north end. The area drained consists of dried-up lakes, absolutely bare and often boulder strewn, and intervening patches of dry marsh land now growing rank with reeds, weeds, and thistles. The outer edges are splendid hay meadows and now support large herds of cattle. The old marsh bed consists of from six to twenty-four inches of tangled reed roots, rotting vegetation, and shell detritus and sand, this making a soft, porous, spongy covering over a hard clay bottom. In some places prairie fires have burned all the covering of the old marsh bed and left a deposit of burnt red clay from six inches to twelve inches deep. Stones seem to be very generally scattered over all this region, particularly noticeable in the dried up lake bottoms. The old marsh proper in its present state is entirely unsuitable to agriculture of any kind.

The main drainage ditch runs the length of the marsh along the road allowance one mile west of the east outline of range 11. Most of the corners fall in the ditch itself, on its banks, or very close to it. For this reason nearly all these corners had to be witnessed and they were witnessed far enough away so as not to be disturbed if ever a roadway were made along the embankment, as is likely to be the case in future roadmaking. The first operation at Big-grass marsh was the closing of the gap in the 5th base line, about three and a half miles. This was done by base line methods, check chaining, correction of slope and temperature, and deflection of the line to put it into theoretically correct azimuth after observation. The outlines of the township were then run, the outer boundaries of the area retraced, and the enclosed area subdivided according to the first system, as closely as the irregularity of the old surveys would allow.

The district surveyed in Moose Mountain Forest reserve was along the north and east slopes of the mountain. The whole of that country is very rolling and scrubby, the Moose mountains being the highest and roughest of it. They originally were covered with a thick growth of poplar, black poplar, and birch, very large stumps and old rotten logs still being seen. Years ago, according to settlers' stories, two fires which were particularly devastating, burned the mountains practically clean, but owing to forest protection, the reserve itself and in some places bordering sections, have developed a thick growth of poplar, birch, hazel, cherry, and underbrush. Lakes, ponds, and sloughs are very numerous, so that this area of forest growth in the middle of a prairie country is a distinct boon to it. Two of the larger lakes are used as summer

resorts, and the smaller lakes, ponds, and hay sloughs make an excellent range for cattle, while the timber is a source of fuel for settlers. All the settlers living around the edge of the reserve keep large herds of cattle in connection with their farming. The reserve boundaries surveyed lay almost wholly in thick bush which had to be opened for retracement. The water in the lakes is mostly alkaline, which is a serious drawback to this vicinity, but attempts to get water by drilling were at last successful this season, an artesian well being struck in tp. 33-10-2. The forest reserve is also a game preserve, consequently bank beaver houses are very frequently seen, and prairie wolves are becoming a veritable pest. Strawberries are being successfully grown on the northern slopes of the Moose mountains.

The townships in which the boundaries lie were surveyed in the eighties, when timber was heavy, and bearing trees and wooden posts were the common type of monuments then used. Heavy fires and new forest growth have almost completely destroyed all old lines and nearly all monuments. The finding of such monuments can be readily seen to have been a most disheartening task. The remains of only one wooden post were found in the whole survey of this district, and bearing trees were found but seldom. In only two or three places have the farmers cultivated the land bordering on the reserve, although fences are run approximately along most of the boundary.

Whitewater lake, which is situated in tp. 3-22-Pr and the surrounding townships, was formerly a very shallow body of water about ten miles by four, with very flat marshy shores. It is really a huge depression in a very flat country, and according to an engineer's report has not sufficient elevation to allow of drainage. It is therefore but a huge catchment basin liable to be low or high according as the snow and rainfall is light or heavy. The winter of 1916 being one of heavy snowfall and the summer being fairly wet, the lake was higher than for several years; as a consequence only the edges were surveyed. The country all about this lake is very flat and unbroken and is excellent farming land, some of the largest and best wheat farms in Manitoba being located in this vicinity.

Lizard lake was a small area consisting of lake and marsh at the time of the original survey in the seventies. At that time the country was very heavily wooded. Since then fires and settlers have destroyed nearly all the bush, and fires in many cases have burnt deeply into the soil, so that old monuments have almost entirely disappeared Retracement of considerable mileage was necessary to get a starting point. At present the lake has mostly dried up and consists of marsh and hay lands with a few ponds of water at the centre.

During the month of October the weather was very bad, and in late December and early January extremely cold. No snow of any account fell until about the last week in December. Owing to this and very hard early frosts the ground froze up quickly so that mounding became a very laborious operation early in November.

Scattered Surveys by E. S. Martindale, D.L.S., in Southern Saskatchewan and Alberta.

These surveys were varied in character, including correction surveys, resurveys, retracement surveys, townsite surveys, and investigation and traverse of water areas; they were scattered over southern Alberta and Saskatchewan, and, being small, did not warrant the expense incurred in detailing a regularly organized party to execute them. Accordingly Mr. Martindale's party consisted only of an assistant and surveyor, labourers being hired locally where necessary and where possible.

In addition to the regular survey work, observations for magnetic declination and total force and inclination, were taken, whenever it was possible to do so without unduly delaying the other surveys.

Field operations were commenced on May 13 by the retracement of the N. by. of tp. 20-29-2 and the E. by. sec. 30, tp. 20-1-3, both near the village of Brownlee in Saskatchewan. The land in this vicinity is gently rolling and is largely under cultivation being devoted mostly to grain growing. Investigations and the necessary resurveys for locating lost corners were made in various townships along the main line of the Canadian Pacific railway west of Moosejaw. In tps. 17 and 18-9-3 several quarter-section corners which had not been established in the original survey because of wet sloughs which have since dried up, were established. Herbert in the former township is a thriving town with a population of about one thousand and is located in the centre of an excellent grain growing district which is evidenced by the presence of seven elevators in the town. The settlers are largely of the Mennonite belief and are unusually thrifty. An experimental farm is located just west of Herbert where different varieties of grain are tested out in plots under various systems of cultivation.

After completing miscellaneous surveys in tp. 18-11-3; tp. 22-8-3; tp. 19-3-3; tp. 16-2-3; and tp. 15-9-3, the party moved westerly to Eastend, via Swift Current, Gull Lake, and Shaunavon. Eastend is a small growing village in the valley of Frenchman river on the Weyburn-Lethbridge branch of the Canadian Pacific railway. It is in the centre of a large district, extending north to the Cypress hills and south to the international boundary, which is being rapidly transformed from a ranching country into a thriving agricultural community. Pottery clay is found in quantity in the vicinity, and some irrigation projects have been developed in the district. Irrigation reservoir sites were surveyed and posted on secs. 17 and 20, tp. 6-21-3. As both reservoirs were dry, the dams in both cases having been carried out by freshets, it was first necessary to run contour lines of high-water level.

Some small jobs were completed in tp. 18-6-3; tp. 11-23-2; tp. 11-2-2; tp. 9-3-2; and tp. 10-3-2 on August 3, after which the party moved to Banff where a contour survey of a proposed new cemetery was made. Some minor alterations were also made in the layout of the St. Julien addition to the townsite.

Banff is the premier tourist resort of the West and has many attractions for the visitor. The headquarters of the Alpine Club are located there and numerous walking and mountain climbing excursions may be arranged for those so inclined, and for those fond of boating Bow river flows with barely a ripple through a narrow valley hemmed in by mountains on both sides for a stretch of nearly eight miles up the stream (westerly) from the town. The bathing facilities are unexcelled with sulphur baths of various temperatures, the most popular being at the lower hot springs where the park authorities have recently completed a magnificient bath house and swimming pool. A museum and a zoo of more than ordinary interest is maintained for the benefit of the visitor. A fine new golf course has also been recently constructed. Automobiles were allowed on most of the drives in the vicinity of Banff for the first time in 1916 and this coupled with the fact that a well-graded automobile road has been constructed from Calgary through the park has made the town a popular rendezvous for auto-touring parties from the prairies. Several well-equipped hotels provide excellent accommodation for the traveller. St. Julien addition is situated on the westerly slope of Tunnel mountain overlooking the town and looking up the Bow river valley; it is laid out to conform to the peculiar topographical features of the location. There is little doubt that in time, with its scenic advantages it will be the most beautiful residential district of the town.

After the work at Banff was completed, restoration, retracement, and other surveys were carried on in southern Saskatchewan and in the vicinity of Medicine Hat until November 29, when the party proceeded to Drumheller to subdivide certain school lands adjacent to that town.

Drumheller is a mining centre situated in the valley of Red Deer river on the Canadian Northern railway in tp. 29-20-4. Eight or ten coal mines are in operation

with an estimated output of three thousand tons per day during the winter months. The coal is semi-bituminous and the mines are drifted in from the foot of the steep slopes of the river valley. The population during the winter months is about two thousand five hundred. Many miners have squatted on the school lands and the subdivision was made in order that the land might be disposed of and incorporated in the town. A traverse of High river in tp. 19-29-4 completed the season's work on January 8, 1917.

Generally speaking the weather was unfavourable for survey operations on account of heavy rains and unsettled climatic conditions during practically the whole season. Although the spring was backward the grain got a good start and in southern Saskatchewan gave every promise of an abundant crop until the hot sultry weather of July and August favoured the spread of the black rust. Very considerable damage was done to the wheat crop in southern Saskatchewan and in Manitoba, but fortunately the blight did not extend far north or into Alberta, where bumper crops were the rule. Numerous severe hailstorms did much damage in some localities in July and August, and heavy rains and snowstorms caused much delay and inconvenience during the harvest. However most of the grain was threshed before winter finally set in. The early winter was unusually severe the temperature falling to–44° F. at Drumheller on December 27.

Because of the heavy snowfall during the preceding winter and the large rainfall throughout the summer the great majority of old dried-up lakes and sloughs are again filled with water.

Very few prairie-chickens were seen while wild ducks were plentiful only in the lakes and sloughs at the western end of the Moose Mountain Forest reserve.

Resurveys by T. H. Plunkett, D.L.S., in Manitoba and Saskatchewan.

The work on which Mr. Plunkett was engaged consisted of small scattered resurveys and retracements, necessitating much travelling.

The first survey, in tp. 32-11-Pr., was reached from Gypsumville over almost impassable roads. Mixed farming is engaged in almost exclusively in this district, and large quantities of hay are obtainable during average seasons on the many sloughs which alternate with poplar ridges.

After completing a small survey at Fairford settlement nine miles south of Gypsumville the party left for Bedford station in tp. 5-9-E., where they were engaged until July 28 on lot surveys.

They then went south to township 4 where surveys were required in section 22.

The district is entirely covered with bush, the growth consisting principally of jack pine, with spruce and tamarack in the low lands lying immediately west of Bedford and Sandilands stations. A small settlement was found at each of these places but little attempt is made to do any farming, the soil consisting almost entirely of sand. The settlers cut firewood in the winter and pick wild fruit in the summer, Winnipeg offering a ready market for both products.

Some small miscellaneous surveys were next done in tp. 6-25-Pr., tp. 12-31-Pr., tp. 23-32-Pr., tp. 30-23-Pr. and tp. 23-27-Pr. in the order named the work being completed on August 30.

The above-mentioned surveys were made in country where settlement has existed for some years. Farming consists principally of grain raising, and flourishing settlements are characteristic of the entire country.

The next work was at Menisino in tp. 1-10-E. and consisted of the subdivision into town lots of a portion of section 35.

Some farming is being done in this locality but the soil in most places is too sandy for successful agriculture.

Jackpine bush on the ridges and spruce and tamarack in the swamps south of the station afford winter work for the settlers cutting cordwood.

On September 16 the party left for Eriksdale, Manitoba, where surveys were required in tp. 22-9-Pr. Large water areas which characterized this district at one time are now nearly all dry. The work consisted of the survey of quarter-sections, which were formerly covered by water. The crops in this locality are principally oats, and buyers at Eriksdale pronounced last season's crop the finest sample of oats in western Canada.

A stadia survey in tp. 23-1-Pr. was the next work. This district is entirely a bush country and as a rule little improvement has been made on the homesteads. Potatoes and other vegetables form as yet the chief crop.

The traverse of lakes evidently omitted in the original survey of tp. 17-19-Pr. kept the party busy from October 12 to 23. The surrounding country is in a flourishing condition and crops were exceptionally good even last season.

The party next made a stadia survey of the water areas in sec. 11, tp. 28-29-Pr. near Togo, Saskatchewan, and from there went to Birch River, Manitoba, where a preliminary survey was made for a proposed subdivision into town lots of portions of legal subdivisions 3 and 4 of sec. 35, tp. 39-26-Pr.

At Birch River station lumbering operations occupy the few residents. The sandy nature of the soil in the immediate vicinity of the settlement prevents agriculture, but two or three miles east and west of the railway the soil is better and the country is fairly well settled. Farming is as yet in its infancy and its development will be slow as this is a bush country.

On November 7 the party left Birch River for Mulvihill, Manitoba, to survey the water areas in tp. 24-4-Pr.

When this work was completed it was decided to close work for the season, as the snow had become too deep for satisfactory surveys.

Scattered Surveys by R. C. Purser, D.L.S., in Southern Saskatchewan.

The surveys done by Mr. Purser were scattered througout the province of Saskatchewan. They were of a small, miscellaneous nature and of many kinds, consisting of the investigation and correction of reported errors in previous surveys, the restoration of obliterated and lost monuments, the settling of disputes arising from imperfectly or incorrectly defined section lines, investigations regarding the necessity of resurveys and river and lake traverses.

The party consisted of the surveyor and one assistant, local help being procured where necessary.

Work was begun in the vicinity of Kamsack, Saskatchewan, during the second week of May. From that time until the middle of September the work lay almost wholly between the Second and Third meridians. After that time many of the surveys lay west of the Third meridian. The season's work was finished in tp. 10-5-3, not far from Gravelbourg, Saskatchewan.

In tp. 30-5-2, two small areas of land which had been set apart and used as public cemeteries by Doukhobour communities were reserved by the Government when the community system was done away with. These parcels of land were surveyed during the early part of the season. They will continue to serve their purpose as public cemeteries, the Government retaining ownership of them.

In tp. 24-2-2 considerable confusion had been caused among the settlers on account of two different witness monuments having been accepted as true section corners. These witness monuments had become obliterated and their true character hidden. It was necessary to retrace over fifteen miles of section lines in order to determine their true nature. Fences had been built and roads graded in accordance with the erroneous assumption that they were true section corner monuments.

In twelve different cases serious errors were found in the positions of section corner monuments. These were corrected in every case except one, the written consent to the correction being obtained from the owners of patented lands affected. In tp. 43-17-2, however, an error of about seven chains remained uncorrected owing to difficulties involved with improvements and a road diversion survey. In tp. 43-1-3 in the St. Laurent settlement a R.N.W.M.P. reserve was resurveyed. This was the site of the old police barracks in the vicinity of Batoche, the scene of action in the Northwest rebellion.

A traverse of a part of Shell river was made in tp. 49-27-2 and of Kneehills creek in tp. 29-21-4. The latter survey was made on the ice in the month of December, the temperature at one time dropping as low as forty-four degrees below zero. Kneehills creek flows into Red Deer river. In this vicinity is the town of Drumheller, Alberta, where coal mining is extensively carried on. There were nine mines in operation at the time the survey was made and over one hundred cars of coal per day were being shipped.

In all about forty different surveys were made during the season. In addition to this work wherever possible observations for magnetic dip and total force were taken twenty-seven different stations being occupied. At twenty-four of these stations three complete sets of observations were taken and at the remainder two were taken.

Base Line Resurveys by A. G. Stuart, D.L.S., in Alberta and Saskatchewan.

On May 5 survey operations were begun by Mr. Stuart on the Third meridian at the northeast corner of township 48, and from this point the meridian was retraced to the international boundary. The line runs through a well-settled country, supplied with good roads and railway facilities, and showing every sign of prosperity.

Having completed this work the retracement of the 14th base line was begun in range 22 west of the Third meridian on September 9. The line was retraced westward to the Fifth meridian, the closing being made on November 13. Most of the party were then discharged, the remainder returning to ranges 24 and 25, where a traverse was made south of the City of Edmonton as it was impracticable to retrace the base line within the city limits.

Upon completion of this traverse observations were taken over the base line eastward to range 12, west of the Fourth meridian, as it was impossible to do the work previously owing to cloudy weather.

The retracement of the Third meridian over the ice on Johnston lake in townships 12 and 13 completed the season's work.

The country travelled over in retracing the 14th base line was much rougher and more undeveloped than along the Third meridian and much more bush and scrubby country were encountered.

During the field season, which lasted approximately seven months, over five hundred miles of meridian and base line were retraced for bearing and chainage, the same being transited, chained, check chained, levelled, and check levelled.

Five hundred astronomical observations were taken and computed as well as one hundred and fifty observations for magnetic declination.

APPENDIX No. 10.

YUKON TERRITORY SURVEYS.

MISCELLANEOUS SURVEYS, BY J. H. BROWNLEE, D.L.S., IN THE YUKON TERRITORY.

One of the works carried on by Mr. Brownlee in the field was the inspection of Mr. H. G. Dickson's contract of 1915. This included the survey of Kluane wagon road from the Dawson-Whitehorse road to Jarvis river and a traverse of certain meadow lands on Dezadeash river in the vicinity of Pine and Bear creeks.

Two surveys were made for the Department of Indian Affairs. The first was a reconnaissance survey of a proposed reserve at Champagne Landing, sixty miles west of Whitehorse. The other was the survey of Little Salmon Indian reserve at the confluence of Little Salmon and Lewes rivers.

Other works performed were, the survey of Thirteen Gulch a tributary of Eldorado creek, and the inspection of certain surveys made by Mr. C. S. W. Barwell, D.L.S., including fourteen miles of traverse from Mayo river to the Silver King mine at Galena creek and the survey of three mineral claims. An examination was also made of the valleys of Indian, Nordenskiold, and Dezadeash rivers, all of which contain unsurveyed lands suitable for settlement.

One draughtsman is employed to assist with the office work. Sketches and blue prints have been made for officials of other departments, but the cessation of mining law-suits during the year has caused a falling off in certified copies of plans and field notes of surveys to litigants and their solicitors. Nineteen plans of official surveys were filed in the office during the year, as compared with fourteen the previous year.

APPENDIX No. 11.

LEVELLING.

IN CHARGE OF J. N. WALLACE, D.L.S.

The mileage levelled during the year and the total mileage run at the end of the year, are as follows:—

	Season, 1916.	Total.
Precise levels	509	2,808
Secondary levels	237	676
Meridian and base line levels	1,058	11,389
Subdivision levels	3,504	4,358
Other lines of levels	91	321
Totals	5,399	19,552

In addition to the above, one line 136 miles long, from Grouard to the Sixth meridian was re-levelled.

Compared with the work done the previous season there was an increase of 1,937 miles. All of this increase, however, is due to the much greater amount of subdivision levels, only 854 miles of subdivision having been levelled in 1915. In precise levels, and in meridian and base line levels, there was a decrease of about forty per cent.

Lines of Precise Levels.

Two parties under L. O. R. Dozois, D.L.S., and E. W. Berry, D.L.S., were employed in running precise levels along railway tracks, a total of 509 miles being thus levelled. Mr. Dozois levelled along the Canadian Northern railway from Rosebud to Calgary, sixty miles, and along the Hudson Bay railway 141 miles, between May 18 and September 28, 1916. The probable errors of the mean result per mile of double levelling is 0·0028 feet for the former line, and 0·0031 feet for the Hudson Bay railway. The latter is somewhat high, and is undoubtedly due to unstable ground, this track being only just laid.

On the former line Mr. Dozois again followed his practice of the previous season of working from 4.00 to 8.00 A.M. and from 4.00 to 8.00 P.M., in order to avoid wind and heat waves inseparable from the prairie during the mid-day hours.

The line from Rosebud to Calgary completed the last sixty miles of a circuit running over the Canadian Pacific railway, from Calgary to Edmonton, and over the Canadian Northern railway, from Edmonton to Warman and Saskatoon, and from Saskatoon to Calgary. This was the first circuit of precise levels entirely levelled by this branch.

The length is 950 miles, and when Calgary was again reached, at the end of the circuit, the levels closed with an error of 0.069 ft. The whole circuit was levelled by Mr. Dozois and Mr. Berry, the former running 611 miles, and the latter 339 miles.

Mr. Berry levelled along the Edmonton Dunvegan and British Columbia railway from Edmonton to Sawridge, 164 miles, and then along the Alberta and Great Waterways railway from Carbondale to the crossing of the 18th base line, which is 22 miles northeast of Lac La Biche station. He began work on May 16 and ended October 23. These two lines of precise levels form the initial stages of two important lines, one of which will ultimately radiate northwesterly towards Pine River pass and Fort George, and the other northeasterly to McMurray. The probable errors of the parts levelled by Mr. Berry have not yet been computed, but his discrepancy in a mile seldom exceeded 0.010 ft. and was never greater than 0.15 ft.

Later in the season Mr. Berry carried a line of levels from Big River to Ile a la Crosse, following the winter road.

The limit of discrepancy allowed in precise levels between the duplicate measures of each mile section is usually 0.017 ft., though the aim in the work referred to above was rather a limit of 0.010 ft. With modern instruments a frequent recurrence of 0.017 ft. in a season's work is unnecessary, and rather indicates undue haste, or too great tendency to work under unfavourable conditions. The average skilful leveller is more prone to go too fast than too slow. A leveller must learn to regard his line as it will be regarded in future years, when the rate at which it was run will be of no interest to anyone. The sole basis on which it will be judged is its accuracy, and the permanence of its bench-marks. In a country so extensive as the Northwest where lines of levels must be run far inland it is a question if a precision indicated by a limit of 0.017 ft. $\sqrt{}$ miles is sufficiently good. In the limit it would mean a discrepancy between the two measures of over half a foot in a thousand miles. Such a discrepancy is too great a difference between the only two measures which are available to determine the final elevation. It may be further noted that the best criterion of the accuracy of a line of levels is not the total accumulation of the discrepancy at the end, which indeed is often absolutely neglible even in a badly levelled line, but the line should be judged by the probable error of the mean result per mile of double levelling. There is little doubt that in future years the precision of many lines of levels now being run will not be considered to have been good enough.

Lines of Secondary Levels.

While precise levels necessarily form the foundation of all other levelling, yet they must keep along railway tracks, and they do not lend themselves readily to the ascer-

taining of local elevations. Their use is, therefore, almost entirely restricted to acting as a control for other less accurate, but more practically useful, lines of levels. The difference, however, between levels intended almost wholly as a control and levels intended entirely for local purposes is too abrupt for an extensive country. An intermediate class of levels is a necessity more effectively to control the errors inseparable from local levels, and to afford satisfactory elevation in advance throughout the country so that individual districts can be levelled independently of one another with a reasonable assurance that no serious conflict will occur when the local levels of neighbouring districts meet. A degree of conflict, which may not be very important in actual practical use, may yet make serious trouble in records. It is for this reason we see all railway companies now striving to co-ordinate their levels over their whole systems where, during the earlier periods of construction, they were content to have each division on its own datum.

The relative mileage of each class of levels is not subject to any definite general rule, but a casual inspection will show that there is a serious want of secondary levels over the southerly half of Manitoba, Saskatchewan, and Alberta. The best general arrangement would be lines of levels running east and west along base lines, and north and south along every fourth range. These levels should be run with an accuracy of 0.030 ft. $\sqrt{}$ miles, this being sufficient in view of their being controlled at intervals of about one hundred miles by the lines of precise levels.

Two lines of secondary levels were run in the northern part of the territory during the past season. One was levelled from Dunvegan to Grande Prairie and from there northwesterly to Pouce Coupe, the line ending at the crossing of the 21st base, range 14, west of the Sixth meridian, a total distance of 166 miles. This line was levelled by J. B. Alexander, D.L.S., who also levelled twenty-nine miles along the 19th base through Grande Prairie. These lines run through a district where there was very little information about elevations, and nothing to serve as a basis for future subdivision levels. Substantial bench-marks, consisting of two-inch iron pipe, four feet long, with a heavy foot-plate and a brass cap, were planted every fourth mile. The pipe is filled with concrete, and the whole is sunk so that the top is eight inches above ground.

Previous to doing the above work, Mr. Alexander had re-levelled 136 miles from Grouard to the Sixth meridian, by way of the town of Peace River. This line had been levelled in 1915, but as it was a line of great importance and had indicated an error of some eighteen feet in the datum supplied to the surveyor of the Sixth meridian, it was considered advisable to re-level the Grouard line. In the result Mr. Alexander confirmed this line. The datum used for the Sixth meridian has, therefore, been revised accordingly.

The other line levelled was from Big River to Ile a la Crosse. This line followed the travelled sleigh road, the water elevation of several large lakes along the route being utilized to transfer elevations. Where the line followed the land the discrepancy per mile was kept within 0.015 ft. Mr. Berry carried out this work between December 9, 1916, and March 19, 1917.

Meridian and Base Line Levels.

During the year 1,058 miles of levels were run along meridians and base lines. Of this total 541 miles were levelled during the original survey of base lines, all of them in northern parts of the territory, and the remaining 517 miles were recorded during the retracement of lines formerly surveyed but not levelled. The most easterly line of levels was that along the Third meridian during its retracement from the international boundary to township 48. Two levellers were employed, but although they agreed with each other within less than 0·10 ft. in each mile, with a total disagreement at the end of less than two-tenths of a foot, the results, where

the line intersects precise lines, are not nearly so satisfactory as such agreement would lead one to expect. A long line of levels run over the open prairie is much more liable to an insidious accumulation of error than the average leveller can be brought to realize.

This line along the Third meridian was the longest single line levelled during the season along meridians or base lines, the next longest being the 14th base also levelled during retracement, from range 22 west of the Third meridian to the Fifth meridian. Two of the other lines exceeded 100 miles each, namely the 20th base line, ranges 10 to 26 west of the Third meridian, and the 29th base line, ranges 8 to 24 west of the Fourth meridian.

In addition to the above long lines, fourteen other shorter lines, totalling 369 miles, were levelled along base lines, the most northerly one being ranges 8 to 17 of the 30th base line, in the district west of lake Athabaska.

Subdivision Levels.

During the subdivision of townships, levels are run along every alternate section line running east and west, and north and south. In regular subdivision this results in nine equal circuits of eight miles each. During the season 3,504 miles were levelled, involving 125 townships in which some, or all, of the interior alternate lines were levelled and in addition twenty townships in which certain outlines only were levelled. In making this count no notice is taken of townships which have levels along an outline which is common to a township already counted. This was only the second season in which levels were taken during subdivision. In the year 1915 only four of the subdividers recorded levels, while in 1916 levels were recorded by all of the fifteen parties employed on original subdivision and by two parties engaged on miscellaneous work. The localities extended from southern Manitoba to the Peace River block.

The average amount of levels per party was 214 miles, or 53 per cent of the surveyed mileage, the latter proportion varying from 61 per cent to 44 per cent, in different parties. These averages include only actual miles of country levelled over, and exclude all check levels. The roughness of the country varies greatly and only one leveller is available on each subdivision while there are two sub-parties surveying the line. During the season 504 circuits were closed, the great majority being eight miles long. These closed over ninety per cent of all lines levelled, and only twenty-one circuits showed an error of over one foot, the average of all being 0·29 ft.

The following tables show the details of all lines levelled during the year ending March 31, 1917.

Precise Levels.

Line.	From	To	Route.	Surveyor.	Miles.
J	17th Base W. Prin. . .	Nelson river.....	Hudson Bay Ry.	L. O. R. Dozois	142
S	Rosebud	Calgary	Can. Nor. Ry....	" ..	62
U	Edmonton.....	Sawridge.....	E. D. & B. C. Ry.	E. W. Berry.....	170
V	Carbondale	Lac La Biche.....	A. & G. W. Ry...	"	135
	Total.	.....	.....	.....	509

Secondary Levels.

P	Big River....	Ile a la Crosse	Winter road.....	E. W. Berry.... . ..	71
T	Dunvegan.....	Grande Prairie....	Wagon road	J. B. Alexander	62
T	Grande Prairie.....	21st base R. 14 west of 6th Mer.....	" . .	"	104
	Total.	.....	.....	....	237

Meridians and Base Lines.

Line.	Townships or Ranges.	Surveyor.	Miles.
Third meridian.	1–48	A. G. Stuart	288
14th base west of Third meridian	22–28	"	37
19th " " "	18–26	G. H. Blanchet	54
20th " " "	10–26	"	101
14th " Fourth "	1–28	A. G. Stuart	163
29th " " "	8–24	J. A. Fletcher	100
30th " " "	8–17	"	56
East outline, range 8, W. of Fourth meridian	113–116	"	24
24th base west of Fifth meridian.	22–25	J. R. Akins	24
25th " " "	22-25	"	22
26th " " "	21–25	"	26
28th " " "	19-24	"	35
19th " Sixth "	4–8	J. B. Alexander	29
25th " " "	1–3	J. R. Akins	18
26th " " "	1–3	"	13
27th " " "	1–3	"	18
28th " " "	1–2	"	12
29th " " "	1–6	"	36
30th " " "	1	"	2
Total			1,058

Subdivision Levels.	Surveyor.	Miles.
Original Subdivision.		
Tp. 32-5-E.; tps. 30, 31 and 32-6-E.; tps. 28, 29 and 30-7-E	J. E. Jackson	111
Tp. 53-12-2 ; tp. 53-13-2 ; tp. 53-14-2; tps. 53 and 54-15-2.	W. H. Norrish	196
Tps. 54, 55 and 57-22-2; tps. 54, 55, 56 and 57-23-2	W. Christie	211
Tp. 58-7-3 ; tps. 57, 58, 59 and 60-8-3 ; tps. 59 and 60-9-3 ; tps. 59 and 60-10-3	P. J. McGarry	158
Tps. 65 and 66-6-4 ; tps. 65 and 66-7-4 ; tps. 65 and 66-8-4 ; tps. 65 and 66-9-4	F. V. Seibert	280
Tp. 84-5-4 ; tps. 79, 81, 82, 83 and 84-6-4 ; tps. 79, 80, 81 and 85-7-4.	R. H. Knight	200
Tps. 71 and 72-18-5 ; tps. 69, 70 and 71-19-5 ; tps. 69 and 70-20-5 ; tp. 69-21-5	D. F. McEwen	272
Tp. 86-16-5 ; tp. 86-17-5 ; tps. 82, 85 and 86-18-5 ; tps. 87 and 88-19-5	J. H. Johnston	296
Tp. 92-22-5 ; tps. 91, 92 and 93-23-5 ; tp. 93-24-5 ; tp. 89-25-5.	J. C. Baker	200
Tps. 95 and 97-19-5 ; tps. 93, 94, 95, 96 and 97-20-5 ; tps. 93 and 94-21-5	J. A. Buchanan	172
Tps. 98 and 99-18-5 ; tps. 97, 98, 99 and 100-19-5 ; tps. 97 and 101-20-5.	J. W. Pierce	136
Tps. 74 and 75-24-5 ; tps. 74 and 75-25-5 ; tps. 74 and 75-26-5	A. E. Glover	245
Tps. 77, 78 and 79-1-6 ; tps. 77, 78 and 79-2-6 ; tp. 77-3-6 ; tps. 78, 79 and 80-6-6 ; tps. 79 and 80-7-6	A. Lighthall	248
Tp. 84-15-6 ; tps. 82, 83 and 84-16-6; tps. 81 and 82-17-6	L. Brenot	159
Tp. 79-17-6 ; tps. 77, 78, 79 and 80-18-6 ; tp. 79-19-6	S. D. Fawcett	227
Miscellaneous.		
Tp. 47-1-3 ; tp. 34-5-3 ; tp. 34-6-3 ; tp. 50-25-3	J. M. Cote	171
Tp. 20-14-4 ; tp. 20-16-4 ; tp. 12-17-4 ; tps. 14 and 15-19-4	S. L. Evans	222
Total		3,504
Sundry lines to provide a datum for subdividers.		91
Total of all lines levelled during the year		5,399

SESSIONAL PAPER No. 25b

Work in the Calgary Office.

The work in the Calgary office has been carried out on the same general lines as indicated in previous reports. The whole system of the levels depends on the lists of the bench-marks of the precise, secondary, and meridian and base line levels, and the records of these bench-marks claim the first attention in each season. With very few exceptions these lists have been kept strictly up to date, and they receive constant and almost daily attention in the way of revisions. Concurrently with these lists the profiles of such of the lines as can afford useful profiles are compiled, and these are also kept well up to date. Many of the older profiles have been re-drawn during the year owing to a better datum now available, the aim being to have all records constantly revised in detail from end to end, and thus avoid any system of having out-of-date records, with notes that certain corrections must now be applied.

The records of the subdivision levels are, as indicated in last year's report, divided into two classes. No lists are made, but one outline plan of each township is prepared on which is entered all the technical information regarding elevations of bench-marks, closing errors, adjustments, etc., and a second outline plan is then used on which every topographical elevation recorded in the field is entered along each section line according to chainage. The former plans have been compiled very fairly up to date, but the latter plans are in arrears, though considerable progress has been made. The preparation of these topographical plans is, however, a much simpler matter than that of the bench-mark plans, the compilation of the latter involving the detail checking of all the field-books, and the adjustment of all the circuits.

A new work has been inaugurated in entering contours on the sectional maps. Each sheet of these maps covers an area of eight townships from north to south, and twelve to fifteen ranges from east to west. There are, therefore, three base lines and one initial meridian on each sheet. In the districts where meridians and base lines have been levelled, which now form a very considerable proportion of Manitoba, Saskatchewan, and Alberta, there are thus always at least four fundamental lines of levels available for each sectional map. In addition there are frequently levels along various outlines of ranges, and the number of townships in which levels have been taken is steadily increasing. The sectional maps are the present best source of information of the topography of the western provinces, and as time goes by they will more and more take the place of the Ordnance maps of European countries which are the standard in daily use for all public and private enterprises. There is always a difficulty in getting information published in intelligent form. Lists and profiles have their place and are valuable, but they do not present the relief of a country in an easily assimilated form. Contour lines are much more graphic, and even when the lines of levels are comparatively far apart, sufficient contours can be drawn, by careful study, to give an approximation of the general relief of a district.

Over a large proportion of the country nothing was previously known of comparative elevations. Even the barest approximation will supply new information. In contouring the sectional maps the interval adopted has been one hundred feet. Fifty and even twenty-five foot contours have been drawn in rarer cases where the sheet covers an exceptionally flat country.

It is not claimed that the course of each individual contour is anything but approximate where it is shown between lines along which levels have been run, but the total number of contours in any area is very approximately correct, and the areas within which this number must occur are comparatively restricted when we have, as a basis, a certain amount of lines of levels and a good general record of the main streams. The contour lines on the sectional maps should be interpreted as dividing the country into zones within each of which the general elevation lies approximately between that of the bounding contours. Five of the sheets, Waskwei, Kokiu, Berens, Firebag and Dufferin, have already been contoured, and others are in hand.

A summary of office work is shown below:—

—	Meridian and base line levels.	Precise levels.	Sub-division levels.	Other levels.	Totals.
Field-Books.					
Received from the field April 1, 1916 to March 31, 1917	78	47	172	24	321
Miles of levels recorded in these	1,373	579	3,504	381	5,837
Field-books entirely examined	29	21	59	9	118
Field-books partly examined	38		45		83
Bench-Marks.					
Number of bench-marks compiled for first time	1,133	740	1,636	295	3,461
Number of miles in which they occur	930	579	2,229	275	3,767
Profiles.					
Number of sheets completed	46				
" miles on same	1,595				
Township Sheets.					
Bench-mark sheets completed			71		
Miles on same			2,229		
Topography sheets completed			57		
Miles on same			1,623		
B.M. sheets not completed			74		
Miles on same			1,275		

WORK OF SUB-PARTY IN CHARGE OF J. B. ALEXANDER, D.L.S.

Mr. Alexander's first work was the running of a single line of levels to check the line run by L. E. S. Bolton, D.L.S., in 1915, from Grouard via Peace River to the southerly end of the levels along the Sixth meridian. Mr. Bolton's line had indicated that the datum previously used for the Sixth meridian, which had been derived from the levels along the 23rd base west of the Fifth meridian, was in error to the extent of 18·13 ft. As all levels along the Sixth meridian, and westerly, were dependent on the datum used at its southerly end, it was considered advisable to determine this datum beyond possibility of doubt.

Work was begun at Peace River on this check line on June 6, and the line levelled southeasterly to Grouard, where connection was made to the gauge of the Irrigation surveys on Lesser Slave lake. The surface of the trail was very rough, though hard, and it was impossible to use a wagon to advantage in going to or coming from work each day. Now that the railway has reached Peace River there is no regular travel over the road between Grouard and Peace River, and it is only used occasionally by some half-breed on a hunting trip.

Mr. Alexander then began work westerly from Peace River on June 29 and reached B.M. 211 on the Sixth meridian, at the north of township 84, on July 11. Three days were lost on this section of the work on account of heavy rains.

The object of this check line from Grouard to the Sixth meridian was to find if any considerable local error had occurred in the original line. In the whole distance of 135 miles there were only two miles where a greater discrepancy than one-tenth of a foot in each mile was found, and at the end of the line the accumulated discrepancy between the single line and the mean of the original duplicate lines was only 0·26 ft.

After completing this work the party moved to Dunvegan, and a duplicate line of levels was carried southerly over the travelled road from Dunvegan to Grande Prairie, then westerly to Lake Saskatoon, and then northwesterly to Pouce Coupé.

June had been a rainless month but July was very wet, scarcely a day having passed without rain. The trails were deep with mud and progress not as satisfactory as hoped for. When the 19th base line was reached in Grande Prairie the main levels were discontinued for a time, and levels were run along the base line for thirty miles, from the east of range 4 to the west of range 8, this distance comprising all of the base line which passed through open country.

The main line of levels was then continued southerly, and lake Saskatoon was reached on August 29. From there the line of levels was run northwesterly, following the travelled road, to Pouce Coupé which was reached on September 23. A connection was then levelled to the Edmonton Dunvegan and British Columbia railway datum at the end of their grade on the east boundary of sec. 30, tp. 78-13-5, and to the 20th base line datum in range 14. The main line of levels was continued north, and ended at B.M. 13 of the 21st base line in sec. 33, tp. 80-13-5.

On October 6, Mr. Alexander moved back to Spirit river to run connections to the subdivision levels of A. Lighthall, D.L.S. The country was very dry; in the whole distance from Pouce Coupé to Spirit river, one hundred and thirty-five miles, only three running streams were crossed.

Shortly after reaching Spirit river there was a change in the weather, which up to this time had been warm and clear, and for three weeks there was snow or rain nearly every day.

Having completed the work at Spirit river the party moved easterly over the Egg lake trail to Smoky river to establish connection with subdivision levels by A. E. Glover, D.L.S. It was found impossible, with the outfit at Mr. Alexander's disposal, to make this connection, and he then went to High Prairie, by the first freight train running east, to connect with subdivision levels by D. F. McEwen, D.L.S. No particular difficulty was experienced in this work which was finished on November 13, thus completing the season's work.

The levels run during the season comprise 136 miles of single levelling from Grouard to the Sixth meridian, 166 miles of duplicate levelling from Dunvegan to Pouce Coupé, 29 miles of duplicate levelling along 19th base line, and 77 miles of duplicate levelling on miscellaneous connections. The whole would be equivalent to 340 double miles. The allowable limit of error between the duplicate levellings on new work was set at $0{\cdot}03$ ft.$\sqrt{}$miles. In actual practice seventy-five per cent was within $0{\cdot}017$ ft. The accumulated discrepancy reached a negative maximum of $-0{\cdot}133$ ft. when nineteen miles from Dunvegan, and a positive maximum of $0{\cdot}091$ ft. at ninety-seven miles. At the end of the line where the 21st base was intersected, the accumulated discrepancy between the duplicate lines was $-0{\cdot}005$ ft.

Permanent bench-marks were established at intervals averaging four miles. These bench-marks are made of two-inch iron pipe, four feet long with brass cap, and a seven-inch cast-iron foot-plate screwed on. The pipe is filled with concrete. Wherever possible these bench-marks were planted on section lines as they are less likely to be disturbed and are more easily found. The subsoil throughout almost all the country worked over is an exceedingly tough gumbo, and the only satisfactory method of excavation for the bench-marks was to use a pick and shovel. This necessitated opening a much larger hole than if a bar and spoon had been used, but the work was done in about one-half the time the latter method would require. A post-hole auger was of no use. In all, fifty-three new permanent bench-marks were placed during the season.

Elevations of the ground were recorded at intervals of approximately one-third of a mile, also elevations of streams, lakes lying within short distances of the line and accessible, base of rail at railway crossings and stations, and particular care was taken to obtain elevations at the corners of sections and quarter-sections wherever the line of levels came near them.

The elevation of Peace river, July 14, 1916, was 1,116 feet and the ground in front of the Hudson's Bay company's store at Peace River is twenty-eight feet higher

than this. The trail to Spirit River rises quickly to an elevation of 1,851 feet at the top of the south bank of the river. There is then a gradual rise until Spirit River post office is reached at an elevation of 2,012 feet. Immediately after leaving the post office, Spirit river is crossed, elevation of water 1,981 feet, and the country rises gradually to the top of the north bank of Burnt river, elevation 2,129 feet, where a sharp drop of 105 feet occurs to the river. The valley of Burnt river at this point is very narrow, and the hills correspondingly steep. At the crossing of the 20th base line, in range 5, one mile south of Burnt river, the elevation is 2,139 feet.

A steady gentle rise continues until, at twenty-nine miles from Dunvegan, a hill rises sharply 226 feet in less than one mile. For the next thirteen miles Saddle hills present alternate ridges and troughs, each successive ridge rising higher, until the summit is reached at an elevation of 3,096 ft., thirty-seven miles from Dunvegan. From this summit the country falls away abruptly to the south, the elevation dropping 735 feet in ten miles, and then, with a few small local hills, falling to an elevation of 2,151 feet at Grande Prairie post office which is sixty-two miles from Dunvegan. Between Grande Prairie and Lake Saskatoon four parallel ridges run almost north and south. The summit occurs seven miles west of Grande Prairie, at an elevation of 2,466 feet.

West of Lake Saskatoon there is a marked rise, over a shoulder of Saskatoon hill, to an elevation of 2,631 ft. at the centre of sec. 5, tp. 72-8-6, after which a succession of rolling hills extends to Beaverlodge which has an elevation of 2,435 feet. From this point the trail runs northwesterly and, about eight miles southerly from Hythe, strikes the valley of Beaverlodge river which it follows up for some twelve miles, and then enters the bush. The country between the headwaters of Beaverlodge river and Pouce Coupé is gently rolling, rising to an elevation of 2,733 feet, the highest point between Lake Saskatoon and Pouce Coupé, at a point a mile northwest of Sinclair lake which is thirty-seven miles northwesterly from Lake Saskatoon. At the boundary between Alberta and British Columbia the elevation has fallen to 2,425 feet. It rises again to 2,701 feet at the summit between Tate creek and a small creek in tp. 77-14-6, after which the fall is pronounced to Bissett creek, one-half mile south of Pouce Coupé post office, the water of which has an elevation of 1,990 feet. A local summit, elevation 2,323 feet occurs one mile northwesterly from Pouce Coupé post office from which point the ground drops rapidly to Dawson creek, elevation 2,015 ft. Going north another local summit, elevation 2,363 ft., occurs between Dawson creek and Saskatoon creek. Saskatoon creek, elevation 2,115 feet, Rolla creek, three miles farther north, elevation 2,141 feet, and Doe creek, one mile south of 21st base line, elevation 2,058 feet, all flow through deep-cut valleys whose banks grow higher very rapidly as they approach Pouce Coupé river. The elevation at the 21st base N.E. cor. tp. 80-14-6 is 2,094 feet.

A heavy fire has recently burned over a large area along the base line east of this point. It is quite likely that a number of the bench-marks placed on trees have been destroyed as there are very few trees standing, and of these none are living.

Work of Sub-Party in charge of E. W. Berry, D.L.S.

On May 29 Mr. Berry commenced work on a line of precise levels along the Edmonton Dunvegan and British Columbia railway from Edmonton to the easterly end of Lesser Slave lake at Sawridge. The initial bench-mark from this line was P.B. M.-H51 on the high level bridge over North Saskatchewan river at Edmonton, established in 1913 by L. O. R. Dozois, D.L.S. when levelling from Calgary to Edmonton. A spur line of levels was first run to Edmonton city B.M.-12, which had already been connected to three precise level lines, namely from Edmonton to Athabaska, Calgary to Edmonton, and Edmonton to Lloydminster. Mr. Berry's lines followed city streets and the city spur line of the Grand Trunk Pacific railway to the terminus of the Edmonton Dunvegan and British Columbia railway. From there levels were run along that railway to Sawridge a distance from Edmonton of 164 miles, and in addition fifteen miles of spur lines were levelled.

Permanent bench-marks, consisting of brass plates on the standard concrete pillars, were erected every four miles as nearly as possible, and a few additional bench-marks were placed on masonry structures of the railway. In all forty-six permanent bench-marks were established on this line.

The elevations of the crossings of ninety-two road allowances of the system of survey, and of the water of twenty-seven lakes and streams were recorded as well as the rail elevations of twenty-five railway stations along the route.

The elevation of the Edmonton Dunvegan and British Columbia railway at its Edmonton station is 2,233 feet. There is a slight upward grade for four miles till the summit between Saskatchewan and Sturgeon rivers is reached at an elevation of 2,264 feet and then a down grade to the crossing of the latter river, where the water is 2,124 feet. The highest point on the line is reached at Busby station which is on the divide between Saskatchewan and Athabaska rivers, and is at an elevation of 2,370 ft.

From Busby the right of way goes northerly towards the valley of Pembina river, and at Debney the railway is about two miles distant from the river. From there the grade follows the general course of Pembina river to its junction with Athabaska river, and then follows the latter river to Smith, the railway keeping to the higher ground above the rim of the river valley.

The railway crosses the river at Smith, after which it runs westerly following the course of Lesser Slave river, at an average distance of two miles. The elevation of Sawridge station is 1,921 feet and of Lesser Slave lake 1,892 feet.

Between Chisholm and Sawridge there are only a few scattered homesteads near the railway stations, but at Sawridge there are two or three excellent quarter-sections forming an isolated patch of cultivated ground in the surrounding muskeg. From Westlock, north and west, a large percentage of the land is swampy, but the levels and topography show that almost everywhere drainage is feasible. It was noted that, where small areas of land had been drained incidentally by the railway ditches, there was a rank growth of oats and timothy grass, which had sprung from seed dropped by the railway contractors' transport wagons. This indicates that all conditions are suitable for growing these crops as soon as the land is drained.

Precise Level Line Along the Alberta and Great Waterways Railway.

This railway commences at Carbondale, a station on the Edmonton Dunvegan and British Columbia railway fourteen miles from Edmonton, and runs in a general northeasterly direction to Lac La Biche, thence north to McMurray. At that time (August 15) trains were running only as far as Lac La Biche. The initial bench-work was P.B.M.-U5, previously established on the Edmonton Dunvegan and British Columbia railway near Carbondale. The work then proceeded without interruption until October 23, when operations were closed for the season about one and a half miles north of the crossing of the 18th base line, and twenty-two miles northeast of Lac la Biche. The total distance levelled from Carbondale is one hundred and thirty-five miles, and in addition four miles of spur lines were levelled.

Thirty-seven permanent bench-marks on concrete pillars and masonry structures were placed at intervals of about four miles. The elevation of the rail at the crossings of one hundred and one road allowances and seventeen railway stations were recorded, and also the water levels of twenty lakes and streams.

The Alberta and Great Waterways railway follows the edge of Sturgeon valley to Bon Accord. The elevation at Carbondale is 2,252, and at Bon Accord 2,304 feet. From Bon Accord the line falls rapidly to the valley of a small tributary of Sturgeon river, and then ascends to 2,202 feet at Fedorah which is the summit between Sturgeon and Redwater rivers. The line then drops to the valley of Redwater river which is at an elevation of 1,980 feet and then rises gradually to an elevation of 2,220 feet at Alpen, which is the highest elevation reached between Redwater river and Lac La Biche. The most extensive area of swamp on the line occurs around this summit, the swamp extending over about six square miles of land. The occurrence of swamp at a sum-

mit is common through the Northwest as the slope of the land becomes less as a summit is approached. From Alpen there is a gradual descent, the line passing near several lakes of considerable size which are tributary to Beaver river. The elevation of the water of lac La Biche is 1,784 feet and that of the railway station is 1,836 feet. There is a summit, 1,960 feet, about ten miles northeast of Spencer siding, beyond which the railway descends to the valley of Gull creek, which is at an elevation of 1,905 feet. The end of the season's work is one and a half miles past this creek.

The greater part of the country from Carbondale to Abee, a distance of forty-six miles, is settled along the railway. Beyond Abee there are considerable swamp areas as far as Lac La Biche, and settlement is scattered.

The permanent bench-marks on the Edmonton Dunvegan and British Columbia railway were made by two men who worked in advance of the level party, while on the Alberta and Great Waterways railway the whole party spent one day each week on this work. The latter arrangement makes the progress of the levelling somewhat slower, but does not materially increase the cost per mile, as the wages and board of two men are saved. It has the advantage that the surveyor can personally inspect the choice of location, as well as the materials and workmanship, and cement is not shipped from camp until immediately before it is required, thus avoiding damage from rain at sidings where there are no agents. The difficulty of providing board for two men in advance of the party, where there is no local accommodation, is also eliminated.

As there was at the time no train service beyond Lac La Biche the whole camp outfit and the materials for making bench-marks, had to be moved on a railway hand-car.

Work was discontinued on this line on October 24, and the party returned to Edmonton.

Level Line P.

The next work done by Mr. Berry was part of a line of levels from Prince Albert to McMurray. This line had been run as far as Big River station at the end of a branch of the Canadian Northern railway, in 1914.

Levelling was commenced on December 22, at P.B.M.-P12 the last permanent bench-mark established in 1914. From Big River northerly the route followed winter trails, and road allowances to the intersection of Delaronde lake with the 15th base line. From there the line runs over winter trails, and across Delaronde lake, Sled lake, and lac La Plonge to La Plonge mission (Beauval, P.O.) From there levels were run across Beaver river and then along the northerly and westerly winter trail to its intersection with the 19th base line, in range 12 west of the Third meridian, and west along the base line to the water of Ile à la Crosse lake. By using the water of this lake, bench-marks were then established near the Hudson's Bay post situated on a tongue of land at the northeasterly part of the lake, and then connection was made by the same means to the bench-marks of the 20th base line where it crosses a northern arm of the lake.

The distance from Big River to the 20th base line by the route followed is approximately one hundred and sixty-one miles. Levels were run over seventy-eight miles. Bench-marks on growing trees were made at distances varying from one-half to three-quarters of a mile along the land and river portions of the line. The reference point is the head of a six-inch nail driven vertically into a small table cut in the base of the tree at the junction of the root and trunk. The tree is blazed immediately above the bench-mark, and the number is carved on the blaze preceded by the letters "T.B.M." In all one hundred and eight bench-marks were established on this line.

Before producing the line from Big River the levels already run in 1914 were retraced backwards for seven miles to P.B.M.-P11, near Bodmin. This was done to ascertain if there had been any disturbance of P.B.M.-P12. The agreement was found to be very close. Connection was made to four bench-marks of the 15th base line in range 2, three bench-marks of the 16th base line in range 9, four bench-marks of the 17th base line in range 10, two bench-marks of the 18th base line in range 9, three

bench-marks of the 19th base line in range 12, and three bench-marks of the 20th base line in range 14, all west of the Third meridian.

Big River is a few miles north of the watershed between Saskatchewan and Churchill rivers and the level line connects a series of lakes all tributary to Churchill river. The elevations of the largest lakes are as follows: Cowan lake, 1,559 ft., Ladder lake, 1,634 ft., Delaronde lake, 1,618 ft., Sled lake, 1,534 ft., Dore lake 1,506 ft., lac La Plonge, 1,476 ft., and Ile à la Crosse lake, 1,380. ft.

La Plonge river is capable of producing considerable water-power. There is a drop of ninety feet in the lower mile and a half of the river and lac La Plonge, which is only seven miles distant, provides a large natural storage basin.

With a small wooden dam, giving a head of about nine feet, this stream at present furnishes electric light for the mission buildings, pumps water by means of a hydraulic ram against a head of eighty feet for the use of the school and presbytery, and drives a small saw-mill. If a larger plant were erected to utilize the full available head of ninety feet it is probable that the efficiency factor would be doubled, and at least 1,000 horse-power would become available. This could doubtless be further increased by impounding the flood waters in lac La Plonge and improving the channel of the river. There is a fall of one hundred and twenty-one feet in Dore river between Dore lake and Beaver river and it is probable that a water-power of commercial value could be developed in Dore river.

The temperature ranged from 0° to −50° during working hours and the ice on the lakes was over four feet thick. The snowfall was very heavy, about three feet on the level, and in the open swamps and on the lakes the trails were drifted badly.

On March 24, 1917, Mr. Berry went to Saskatoon and made a connection to the levels run by Mr. J. M. Cote, D.L.S., when he was retracing the subdivision of tp. 34-5-3, thus furnishing a known datum for all Mr. Cote's levels in the adjoining townships.

WORK OF SUB-PARTY IN CHARGE OF L. O. R. DOZOIS, D.L.S.

The first work done by Mr. Dozois was the completion of sixty miles of the line of levels along the Canadian Northern railway from Saskatoon to Calgary, the levels having been run as far west as Rosebud the previous season.

Operations were commenced on May 19, the initial bench-mark being No. S-140 established on the concrete foundation of the hotel at Rosebud. A connection was also made to bench-mark No. S-139, two miles farther back on the previous line, to ascertain if there had been any relative movement of the bench-marks. A very close agreement having been found, the line of levels was then carried westerly to Calgary, which was reached on June 22.

The connection with the precise level bench-marks at Calgary closed a circuit levelled by this branch through Edmonton, Warman, and Saskatoon, the total length of which is 951 miles. The closing error is +0.069 ft., that is, commencing at Calgary and following the levels northerly to Edmonton, easterly to Warman, southerly to Saskatoon, and then southwesterly back to Calgary, the final elevation is 0.069 ft. higher than the one commenced with.

There are thirty-six permanent bench-marks in the sixty miles, fifteen being established on specially made concrete pillars, and twenty-one on concrete bridges. These bench-marks had been made in the previous season, so that they were ready for connection as the line of levels was being carried forward this season.

There is a steady rise all the way from Rosebud to Calgary, the total amounting to 852 feet when Calgary is reached. The railway leaves the valley of Rosebud river at the confluence of Serviceberry creek and follows the valley of the latter until more open country is reached.

Level work on this line was carried out only in the early morning and late afternoon in order to avoid the heat waves and the wind which occur during other hours of the day. Actual levelling was begun between 4.00 and 4.30 a.m., and was discontinued about 8.00 a.m. No levelling was then done till about 4.00 p.m., when work was

resumed and continued till about 8.00 p.m Much more precise results were obtained in this way than if the ordinary hours of work were utilized.

The total accumulated discrepancy between the backward and forward levellings amounted to —0·011 feet at the end of the sixty miles, the maximum being —0·079 feet at a distance of forty-nine miles. The rapid descent to Bow river valley at the end seems to have had a marked effect on the discrepancy, causing a positive accumulation of 0·068 ft. in the last eleven miles. The total distance of sixty miles is divided into seventy-two sections, each averaging nine-tenths of a mile. The discrepancy between duplicate levellings exceeded 0·010 ft. in only seventeen cases.

The probable error of the mean result per mile of double levelling is ± 0·0028 ft., and for the whole length of sixty miles is ± 0·0218 ft.

The next work was a line of precise levels along the new Hudson Bay railway being a continuation of the line run two years previously, the end of which was at Mile 100 from Pas.

It was decided that any concrete pillars required for bench-marks would be made by the main party, instead of following the usual practice of specially hiring two men who were sent ahead of the main party to erect the pillars at suitable points. Such an arrangement is the best on railways that have a daily train service, and which operate through a settled country but as the Hudson Bay railway is only in the construction stage, the making of the pillars by the level party itself appeared to be the best practical solution of the question. By arranging so that the first work undertaken when arriving at a new camp was the construction of the pillar, an interval of a week or ten days was allowed for the concrete to set and harden before its elevation was recorded on the last day at the same camp.

The line of levels was continued from Mile 102 to Mile 241, where work was ended for the season on September 28 on a bench-mark established on the Manitou bridge at the first crossing of Nelson river. In a few cases short branch lines were run to determine the elevations of neighbouring large lakes. Connections were made to the levels previously run along the 18th and 19th base lines west of the Principal meridian, along the meridian, and along the 20th base line east of the meridian. These connections entailed running thirteen miles of additional levels. The elevations of thirteen lakes, fourteen streams, and twenty-eight crossings of section lines were determined, involving ten miles of branch levels.

The track over which the levelling was done was, generally speaking, well ballasted all the way. The part as far as Armstrong lake, Mile 226, was finished in 1914, and steel was laid as far as the bridge site at Nelson river, Mile 241, in the year 1915. The bridge was completed during the past winter and steel laying resumed this spring (1916). All the right of way has already been cut out, and most of the grading completed as far as Port Nelson.

The elevation of the Hudson Bay railway station at Pas is 880 feet. The initial bench-mark where work has commenced at Mile 100 is 837 feet and that of the final bench-mark at Mile 241 is 680 feet. This gives a fall of forty-three feet over the first hundred miles and 157 feet in the next one hundred and forty-one miles, with a balance of 680 feet in the last 184 miles to the sea at Port Nelson. The elevation of the railway where it crosses the Principal meridian, at Mile 197, is 675 feet.

The permanent bench-marks established on this line should be exceptionally stable. Concrete pillars, the foundation of which rests on solid rock three and a half to six feet below the surface were specially built, and twenty-nine brass caps were established in holes drilled into rock ledges partially exposed above the surface of the ground, making a total of thirty-nine bench-marks in 141 miles levelled.

The accumulated discrepancy reached —0·132 feet at forty-five miles from the beginning. From there it decreased to — 0·055 feet at sixty-two miles, after which it increased to its maximum, —0·140 feet at ninety-eight miles. During the remainder of the distance it gradually diminished to a total of —0·032 feet at the end of the season's work.

The probable error of the mean of a mile section is ± 0·0031 feet and that of the whole 141 miles is ± 0·0361 feet. Out of a total of 157 sections, each averaging nine-tenths of a mile, the discrepancy exceeded 0·010 feet in only forty-four cases.

APPENDIX No. 12.

REPORT OF THE SURVEYS LABORATORY.

During the past year in addition to the regular tests of D. L. S. transits, tapes, etc., a large number of engineers' transits and levels for use overseas with the Railway Construction Corps have also been examined and tested for the War Purchasing Commission. In spite of the large amount of routine work several investigations in optical and other lines have been successfully carried out and many improvements made on the apparatus.

Comparator Section.—At the Comparator Building a much needed addition has been supplied by the installation of an automatic temperature regulator to control the electric heating system in the testing room. This regulator was supplied by the Johnson Service company and is of their standard type for regulating electric heating circuits. It is located at the centre of the testing room, the main controlling device being placed over the switchboard. The controlling apparatus consists of an alternating current magnet switch controlled by an alternating current relay which is in turn actuated by the thermostat. The low voltage current necessary for the operating is furnished by a small transformer mounted on the board.

The room, as mentioned in a previous report, is heated by two sets of electric radiators each set being wired for three degrees of heat. In order to have as even a temperature as possible it was decided, when installing the regulator, to arrange so that each circuit could be either fed through the regulator or directly from the mains. This was accomplished by installing a second switchboard beneath the existing one and providing a second set of switches connected to the heaters. The bus-bars of the new board are fed through the regulator, so that by suitably combining the circuits on the two boards the heating current may be divided, part being always in operation while the remainder is under control of the thermostat.

The thermostat is adjusted so as to maintain the temperature of the room within one degree either above or below the standard temperature, 62° F.

The weekly base determinations mentioned in the report for 1915-16 have been continued throughout the year and valuable information concerning the base is being obtained. Several minor additions and improvements have been made to the apparatus. Among other tests the screws of the three micrometer microscopes on the 4-metre rule carriage have been calibrated.

Thermometer Testing Section.—A thermometer comparator for the precise testing of laboratory thermometers has been installed. This apparatus was modelled after the comparator in use at the Bureau of Standards in Washington and is adapted for the comparison of thermometers with one or more primary standards from about 5° C. to 90° C. and may be used either in the vertical or horizontal position.

The thermometers used as standards have been calibrated at the International Bureau, Paris, and at the Bureau of Standards, Washington.

It is expected that as the facilities possessed by the Surveys Laboratory for the accurate comparison of thermometers become more widely known, manufacturers and others in Canada will make use of the opportunity for having their instruments compared with the standard scale of temperature.

Watch Testing Section.—Of the sixty-six watches completing the test, twenty-nine, or forty-four per cent passed. This represents the same percentage of passes as in 1916.

The results of the trials of the watches which passed are tabulated herewith:—

SURVEYS LABORATORY—RESULTS OF WATCH TESTS.

BUREAU OF STANDARDS METHOD.

PASSED.

Name.	Number of Watch.	Escapement, Balance Spring, etc.	Mean deviation of daily rate.	Mean of daily rates for each pair of position tests.	Deviation for change of position.	Maximum difference between mean rates of position tests.	Difference between mean rates of P.U. and D.U. positions.	Difference between mean rates of D.U. and D.D. positions.	Progressive change of rate for position tests.	Recovery of rate.	Change of r. per 1° C.		Algebraic difference between A and B.	Isochronism error.	Relative performance.
											A 4°:4–18°:3	B 4°:4–32°:2			
Maximum values allowable.			0s.75		3s.0	10s.0	5s.0	4s.0	3s.0	6s.0		0s.20	0s.3	3s.0	
															p.c.
Waltham Watch Co.	18028542	D.r., g.b., l.e., s.o.	0 31	+ 0·14	0·66	2·32	0·77	0·22	−0·53	−2·43	−0·09	+0·03	0·12	+1·8	68·1
"	18091085	"	0·29	− 0·84	1·04	3·70	0 55	1·76	−0·10	+1·34	−0 03	+0·06	0·09	+0·5	67·4
"	T.S. 802	"	0·30	+ 4·09	1·51	4·99	0·38	1 72	+0·89	+2·46	−0·01	+0·02	0·03	+0·8	65·7
"	19001067	"	0·28	− 1·64	1·54	5·26	1 38	1·13	+0·08	−0·53	−0·13	−0·01	0·12	+1·7	64·7
"	17162246	"	0·27	− 1·57	1·88	6·41	0·82	0·21	−0·70	+1·90	−0·04	+0·03	0·07	+0·6	61·4
"	18091055	"	0·36	+ 0·41	1·37	5·52	0·07	0·73	+0·18	+1·50	+0·16	+0·11	0·05	−0·5	59·6
"	18091074	"	0·29	− 0 53	1·80	7·98	3·32	0·88	+0·31	+0 37	−0 18	−0·11	0·07	+0·7	59·0
Hamilton Watch Co.	688584	"	0·25	+ 1·34	2·26	9·02	2·40	0·26	+0 35	+0·93	−0·06	+0 04	0·10	+0·4	57·5
"	688360	"	0·23	+ 3·51	1·72	7·23	2·69	0·25	+0·71	+1·03	+0·04	+0·15	0·11	0·0	56·5
"	688377	"	0·51	+ 6·36	1·33	5·18	0·95	1·48	+0·75	+2·27	+0·07	−0·02	0·09	−0·5	55·5
"	688005	"	0·26	+ 2·44	2·74	8·12	4·83	2·61	+0·36	+1·17	−0·11	−0·08	0·03	−0·7	53·5
"	688370	"	0·29	+ 3·73	1·18	3·83	3 11	1·13	−0·43	+2·33	−0·12	+0 10	0 22	+0·2	53·3
Waltham Watch Co.	16167502	"	0 38	+ 2·24	2·04	7·08	2·91	2·92	+0·47	+0·64	−0·05	+0 07	0·12	−1·0	52·3
"	18028583	"	0·52	− 5·36	1·79	5·07	1·31	1·96	−0·49	+3.74	+0·06	+0·02	0·04	+0 4	51·7
"	T.S. 491	"	0·26	− 1·06	2·33	6·44	5·12	2·37	−0·03	+0·80	−0·15	+0·04	0·19	+1·5	51·6
"	17162252	"	0·37	− 4·64	2·22	8·75	3·33	1·21	+0·15	+2·70	+0 11	+0·12	0 01	+1·2	50·8
"	18091036	"	0·24	− 6·21	1·82	7·42	1·25	0·36	+0·13	−0 80	−0·34	−0·21	0·13	−0·1	50·3
"	19001012	"	0·44	− 9·71	1·30	5·66	0·30	2·90	+0·15	+1·33	−0·29	−0·17	0·12	−0·4	49·7
Hamilton Watch Co.	688371	"	0·30	− 5·60	1·29	4·52	1·82	2·77	+1·86	+2·06	+0·01	+0·20	0·19	+1·4	48·4
Waltham Watch Co.	18028508	"	0·30	+ 1·14	2·26	8·83	3·16	0·67	+0·31	+5·30	−0·14	−0·07	0·07	+1·9	48·1
"	18091027	"	0·32	+ 0·14	2·26	7·63	1·05	0·07	−0·34	+2·07	−0·23	−0·10	0·13	−0·2	47·6
"	18028502	"	0·33	−10·71	2·68	7·05	4·60	0.20	+0·52	+1·37	+0·03	+0·13	0·10	+0·2	44·3
"	19001065	"	0·43	− 7·15	1·63	4·09	3·20	3·67	+0·20	+1·54	−0·34	−0 20	0·14	−1·7	43·7
Hamilton Watch Co.	688341	"	0·49	+ 0·13	2·16	7·41	1·27	1·15	+0·26	+3·90	+0·03	+0·09	0·06	+1·3	43·4

Waltham Watch Co.	18091083	"	0·40	− 7·75	2·84	9·57	1·33	1 85	−0·23	+3·57	−0·12	0 00	0·12	+2·1	42·6
"	18091035	"	0·48	+ 3·08	1·90	7·43	2·83	1·23	+0·32	+2·64	−0·28	−0·17	0·11	+1·1	40·7
"	18091089	"	0·50	− 4 02	1·20	4·06	2·26	1·80	+1·33	+4·80	−0·29	+0·04	0·33	+1·0	38·5
Hamilton Watch Co.	688366	"	0·39	+ 2·85	1·94	7·54	4·06	1·69	−0·32	+5·53	−0·29	−0·08	0·21	+1 9	38·5
Waltham Watch Co.	18091038	"	0·66	− 1 11	1·35	3·75	3·75	0·40	+0·61	+5·17	−0 15	+0·09	0·24	−0·5	31·6
		Means.	0·36	3·43	1 79	6·27	2·24	1·37	0·45	2·28	0·14	0·09	0·12	0·9	

D.r. = Double roller ; g.b. = Going barrel ; l.e. = Lever escapement ; s.c. = Single overcoil. P.U. = Pendant up ; D.U. = Dial up ; D.D. = Dial down.

For the twenty-nine watches which passed the test; the average variation of daily rate for the position and temperature tests were as follows:—

Position Tests.					Temperature Tests.		
P.U.	P.R.	P.L.	D.U.	D.D.	D.U.	D.U.	D.U.
90°F.	90°F.	90°F.	90°F.	90°F.	40°F.	65°F.	90°F.
0s.30	0s.34	0s.42	0s.35	0s.24	0s.51	0s.35	0s.34

The smallest mean deviation of daily rate was as in 1916, $0^{s}\cdot23$.

The average errors for position were:—

P.U.	P.R.	P.L.	D.U.	D.D.
1s.84	2s.36	2s.56	1s.27	0s.92

The smallest mean deviation for change of position was $0^{s}\cdot66$ as compared with $0^{s}\cdot75$ in 1916. Comparing the average errors with those for 1915 and 1916 we have the following:—

	1915.	1916.	1917.
Average mean deviation of daily rate..	0s.53	0s.49	0s.36
" " " for change of position.. ..	1.89	2.08	1.79
" change of daily rate per degree centigrade.	0.08	0.09	0.09

The average isochronism error for the twenty-nine watches passing test was $0^{s}\cdot9$, and the average marks obtained 51·9; the highest 68·1.

Again this year, as in 1914, 1915 and 1916, the largest average error for the position tests for watches passing the test was in the P.L. position.

Of the watches which failed, seventeen, or forty-six per cent, failed in position only; two, or five per cent, failed in temperature correction only; and one, or three per cent, in isochronism only. The remaining seventeen, or forty-six per cent, failed to pass more than one tolerance. Of the latter, nine, or twenty-four per cent of the total failures, failed in both position and temperature correction.

APPENDIX No. 13.

List of Surveying Instruments on Hand, March 31, 1917.

Instruments.	In Store, April 16.	Purchased.	Sold.	Balance.		Remarks.
				Loan.	Store.	
Abney levels	41		6	2	33	
Alidades	1				1	
Altazimuths	1				1	
Aneroids	91			13	78	
Artificial Horizons	4			1	3	
Base line apparatus	1				1	
Cameras and Kodaks	18			3	15	
Chronometers and Sidereal watches	55	2	3	5	49	
Compasses	34				34	
Current meters and logs	4				3	1 struck off.
Dip circles	2				2	
Field glasses and binoculars	6			4	2	
Levels	53			11	41	1 struck off.
Levelling rods	80			19	60	4 struck off. 3 put back in stock.
Micrometer telescopes	8				8	
Optical squares	1				1	
Pedometers	2				2	
Photo-theodolites	5			2	3	
Plane tables	1				1	
Protractors	78			19	58	1 lost.
Rod levels	19	1			20	
Sextants and reflecting circles	3				3	
Solar compasses	2				2	
Stadia rods	48	3	17	2	32	
Stadia Slide rules	61			10	51	
Steel tapes	139	32	26	8	130	7 struck off.
Subsidiary standard measures	90		11		79	
Survey pickets	2				2	
Surveying cameras	4				4	
Tally registers	12				12	
Tape stretching apparatus	1				1	
Telemeters	1			1		
Thermometers	14		2	7	5	
Transit Theodolites	64	6	2	11	56	1 struck off.
Zenith Telescopes	1				1	